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A PHILOSOPHICAL DISSERTATION ON THE DIVING VESSEL PROJECTED BY MR. DAY, AND SUNK IN PLYMOUTH SOUND;

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CONTAINING,

I. An Hiſtorical Account of Mr. DAY, and the SCHEME.
II. The Conſtruction of the VESSEL.
III. The Operation of the SINKING EXPERIMENT.
IV. A PHILOSOPHICAL INVESTIGATION of the FAILURE of the EXPERIMENT.
V. The ENDEAVOURS made uſe of in Weighing the VESSEL.

TO WHICH IS ADDED,

AN APPENDIX,

Shewing the Various Methods of Weighing Ships in general.

The Whole illuſtrated with Two COPPER PLATES.

BY N. D. FALCK, M.D.

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BRITISH MUSEUM

PREFACE.

MY motive for undertaking the laborious and expenſive taſk of raiſing the unfortunate Diving Veſſel at Plymouth was to render myſelf ſerviceable to the Public; the ſame inducement has prompted me to this publication: but as a bare deſcription of this ſingular contrivance, and a detail of my frequent diſappointments would be too inſignificant to trouble the world with, I have, to the beſt of my judgment, blended the whole with uſeful obſervations, in hopes to render this work beneficial as well as amuſing to my readers, and flatter myſelf the judicious will find ſomething in it worth their attention.

There is a predominant paſſion reigning in the breaſt of every man, which, "like Aaron's ſerpent, "ſwallows up the reſt," mine is that of benefitting mankind. And though in this late ſingular undertaking I ſtand condemned by prudence as a tranſgreſſor againſt her Laws reſpecting myſelf, and in having been miſled by my good opinion of mankind; yet I am ſo far from being dampt in my purſuit, that it is rather an excitement to much ſuperior undertakings; nay, I congratulate myſelf on being capable of committing ſuch an error.

In undertaking the taſk, I laboured under many diſadvantages, which, blinded by philanthrophy, I could not ſee in the ſame point of view as experience has ſince forced me to do: for in the firſt place, my motives for raiſing this veſſel being ſo very oppoſite to thoſe that influenced the parties concerned in ſinking her, my intentions became liable to be miſconſtrued, like thoſe of an honeſt tenant that enters a houſe of ill fame; and ſecondly, becoming inadvertently a rival in a buſineſs foreign to my profeſſion, I felt the effects of envy from thoſe who would feign have appropriated to themſelves the ſuperiority in the employment of riſing this object; though lulled aſleep by my own conſciouſneſs I imagined myſelf wholly ſecure from it.

As occurrences however teach us many leſſons in life, I have reaped ſome advantages reſpecting myſelf, which I could not have done had I actually been ſucceſsful; and regret only with reſpect to ſociety that I was diſappointed in my intentions for the good I meant thereby to have laid a foundation to; as my aim was not bounded by the narrow limits of ſelf-intereſt: but I will not detain the reader any longer from the work, of which I ſhall intreat him to judge with candour.

N. D. FALCK.

ERRATUM. *For* Charles *read* Chriſtopher.

THE

HISTORY OF THE SCHEME,

AND CONSTRUCTION

OF THE

DIVING VESSEL.

MR. DAY, the unfortunate projector of this ſingular piece of invention, was a man very illiterate and indigent in his circumſtances. He was bred, it ſeems, to no particular trade, but had been employed as a labourer amongſt the ſhip-carpenters at Yarmouth, his native place; and where he is yet remembered as an ingenious man.

It appears that this project had for ſome years been a favourite ſcheme of his imagination, from which he promiſed himſelf great emolument. It is reported that he once procured a boat, in which he built a ſmall chamber, and ſuffering the tide to flow over him, he remained under water for above ſix hours; but where this experiment was executed, I have not been able to learn.

Having however propoſed his ſcheme to Charles Blake, Eſq; as an affair by which much money might be won, his offer was accepted of. In conſequence of which he came to London, where he finiſhed a model (ſuch as it was) of the ſcheme; which being approved of, he was ſent to Mr. Hunn, ſhipwright at Plymouth, where he arrived ſome time in the month of March 1774, in order to carry the plan into execution.

Accordingly a ſloop, called The Maria, of about fifty tons burthen, was purchaſed from Mr. Sparks, the owner and commander, for three hundred and forty pounds, which was begun to be fitted out for the experiment the latter end of the ſame month with all expedition, under the inſpection of Mr. Day, and accordingly was finiſhed about the middle of June, when ſhe was towed out from the Pool to her deſtined place: Mr. Blake then arrived at Plymouth. She was ſunk at two o'clock in the afternoon the 20th of June, and Mr. Day deſcended with her into perpetual night!

With reſpect to the character of this unfortunate man, as reported at Plymouth, it ſeems to have been ſuch as was not adapted to pleaſe.

His temper was gloomy, reſerved, and peeviſh; his diſpoſition penurious; his views pecuniary; and he was remarkably obſtinate in his opinion, and jealous of his fame. But withal, he was allowed to be penetrating in his obſervations; acute in his remarks; faithful to his patron; and unſhaken in his reſolutions.

His fate however is to be regretted! as his talents appear to have been ſuch, which if they had been properly cultivated by education, would doubtleſs have rendered him an uſeful member of ſociety.

THE

THE

CONSTRUCTION OF THE VESSEL.

THE purport of the experiment was to prove the practicability of a ſingle man's being able to ſink a ſhip, to remain with her under water for a conſiderable time, and to riſe with her at pleaſure.

With reſpect to the utility or advantages that might be farther intended, is not my preſent buſineſs to inquire into; I ſhall therefore proceed to the principles of the mechaniſm deſigned to effect ſo ſingular an experiment.

The principles of the mechaniſm were theſe; 1. In a veſſel for this purpoſe ſhould be a cloſe chamber of dimenſions ſufficient to contain air to ſuſtain the life of a man for a certain limited time under water.

2. The veſſel ſhould have weight enough affixed to it, which when ſhe was full of water (the air-chamber excepted) would ſink her.

3. The faſtening of the external weight ſhould be ſo contrived that the man in the air-chamber might be able to diſengage it from the veſſel; when, naturally, the air-chamber would buoy the veſſel up to the ſurface of the water again.

Such was the plan of Mr. Day's model, finiſhed by himſelf, though in a very rough and imperfect manner. Mr. Hunn, a man of ſkill in his profeſſion, who was to execute the deſign, foreſaw many difficulties, and the art it required to build a chamber of dimenſions to contain a ſufficiency of air for a man to ſubſiſt for twenty-four hours, tight enough to exclude, and

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I ſhall deſcribe then the veſſel as I have conceived it to be, from the different converſations I have had with Mr. Hunn on the ſubject; and flatter myſelf I ſhall be able to convey a pretty exact idea of its mechaniſm.

The veſſel procured for the purpoſe was a ſloop of thirty-one feet keel, ſixteen feet beam, nine feet hold, meaſuring fifty tons: She was old, but yet in a very good condition; and during the building of the chamber, was graved, corked, ſheathed, and put into good repair for the purpoſes intended.

Midſhip in this ſloop, a little towards the bow, including two of her longeſt beams, was built the air-chamber; its dimenſions in the clear twelve feet long, nine feet broad, and eight feet deep, meaſuring within in clear ſpace, excluſive of the internal timber, ſeventy-five hogſheads.

The ſkeleton of the chamber conſiſted of a floor frame of ſix beams athwart ſhip; the ends of which were ſcarfed into two other beams length ſhip to compleat the frame of the floor. From this floor were erected ſtrong poſts, ſix on each of the two long ſides, correſponding with the ends of the floor timber, and four poſts on each of the ends of the chamber fore and aft.

On theſe poſts or ſide-timber was laid the deck frame, conſiſting of ſix arched beams, ſcarfed into two length ſhip beams, the ſame as the floor frame.

The whole frame of the chamber was ſcarfed, bolted, and ſecured with knees on all ſides within.

Betwixt the beams, and upright ſide-poſts of this frame, timbers of ſmaller ſize were placed, which were carefully ſcarfed into their reſpective beams like the afore-mentioned.

To ſupport the chamber on all ſides againſt the preſſure of the water, it contained two rows of ſtout ſtanchions, four in each row fore and aft, about three feet every way aſunder, which were tenanted into the floor and deck beams of the chamber.

Theſe ſtanchions were again ſupported with croſs beams or carlings in the middle of the chamber, betwixt themſelves, and from all ſides, amounting to twenty-two in all.

And from the corners were erected ſtrong ſhores, bolted and ſecured with knees to the ſtanchions.

The frame, thus compleated, was covered all over with two-inch planks, which were fayed and nailed to all the timber of the external frame; and after the ſeams were well corked, the chamber was all over again ſheathed in a contrary direction to the planks, and the ſeams ſecurely pitched.

The chamber, thus finiſhed, was fixed in the ſloop on four beams athwart in the hold; which beams were ſecured with knees and bolts through the cieling and ribs of the veſſel, and propped up with ſtanchions from the kelſon of the ſloop, from which the bottom of the chamber was about three feet diſtance.

In the middle of the deck of the chamber was a ſquare ſcuttle juſt big enough to let in a man; this ſcuttle declined inwards from its edge, becoming gradually narrower, in order that the hatch, or more properly the valve, which was to cloſe the chamber, might be drove in the tighter.

The valve was made to correſpond to this ſcuttle to the greateſt niceneſs poſſible; and in order to cloſe it with eaſe, it was ſuſpended

pended in a kind of a balance over the ſcuttle, and counterbalanced with a weight.

To the valve were fixed four chains, with which he hauled it down; and to the beams were affixed ſcrews, by which he ſecured the valve as cloſe home as it might be poſſible; but in order to open it again, it was to be knocked up with a handſpike.

The valve as well as the ſcuttle were both lined with flannel on the correſponding ſides, in order that the ſcrews might force in the valve with the greater tightneſs.

On the deck of the chamber were fixed three buoys of different colours, namely, white, red, and black: they were fixed with plugs in ſuch a manner, as to be ſent up by driving another plug from the inſide of the chamber.

Theſe buoys were deſigned as ſignals of the ſtate of health Mr. Day might be in during his ſtay under water; the white was to denote his being *very well*; the red, *indifferent*; and the black, his being *very ill*.

The external ballaſt, by which the veſſel was to ſink, and in diſengaging it was to riſe again, was thus contrived. From the chamber through the bilge of the veſſel were four leaden pipes, about ſix feet aſunder, two on each ſide, and about two feet from the keel; through theſe pipes went iron bolts from the outſide of the veſſel into the air-chamber: externally, under the bilge of the veſſel, each bolt had a ſtrong ſhoulder, through which was a large ring that held the ballaſt; and inſide the chamber the bolt had a ſcrew, to which was fitted a nut with a lever, which, on being unſcrewed, the bolt, with the ballaſt appending thereto, was to ſlip through the pipe, by which the veſſel was to be diſengaged from her external ballaſt, and at liberty to riſe; and to prevent the water filling the chamber, plugs were ready to drive into the pipes as the bolts ſlipt through.

The ballaſt conſiſted of twenty rough ſtones, each of a ton weight; in each ſtone was an iron ring-bolt run in with lead; five of theſe ſtones were ſlung into each ring of the bolt that went into the chamber, with a three inch and half rope; ſo that the ballaſt projected conſiderably below the bottom of the veſſel.

In the fore part of the veſſel were fixed two ſluices for letting the water in; they conſiſted of two leaden pipes going through the bottom of the fore part of the veſſel, in which were fitted ſluice plugs that were long enough to come through the fore-caſtle, which being drawn up, the water was let in. And to prevent theſe plugs being loſt, whilſt the veſſel was under water, they were ſecured to the fore-caſtle, or the deck, with a ſmall rope.

Such was the mechaniſm of this veſſel; and now I ſhall proceed to the execution of the experiment.

THE

OPERATION OF THE EXPERIMENT.

THE veſſel was ballaſted internally with ten tons of lime-ſtones; theſe, together with the external twenty tons, he imagined would be ſufficient to ſink her when ſhe was let full of water; the intention was alſo no doubt to ſink her ſo, that the external ballaſt ſhould firſt take the bottom, ſo that the veſſel ſhould partly be ſuſpended without her keel touching the ground, in order to render her more capable of making her way up to the ſurface at the diſengaging her ballaſt.

He was however ſo confident of his ſucceſs, that he would not admit the neceſſity of any precautions with reſpect to fixing any thing to the veſſel by which ſhe might be weighed in caſe of a failure of the experiment, which might eaſily have been done.

When the day for the experiment arrived (which was conducted with great ſecreſy) he appeared more than ordinarily chearful, and watched the hour with the greateſt impatience, and with the moſt ſanguine expectations, confident that his enterprize would be crowned with ſucceſs and univerſal acclamation.

His equipment for the deſcent conſiſted barely of a hammock, a watch, a ſmall wax taper, a bottle of water, and a couple of biſcuits; and having near him a barge, on board of which were his patron Mr. Blake and his ſervant, the bargeman, his mate and another labourer, he went to execute his grand and laſt experiment. He drew out his plugs on the fore-caſtle, and let in the water, with an intent to ſink; but finding that the ballaſt he had provided was not ſufficient to ſink her, he ordered more ſtones to be hove in; ſtones were accordingly fetched from the neighbouring quarries, the boards on the quarter-deck and fore-caſtle were torn up, and ſtones were hove in to the amount of about twenty tons before ſhe ſunk.

When the veſſel was juſt ſinking, he ſtripped off his coat and waiſtcoat, ſaying, "He believed he ſhould have a hot birth of it," bad them all good bye, retired into the chamber with the greateſt compoſure, and drew down the valve; the bargeman then went on board, and called out to him, to "know, whether he ſhould knock home the ſcuttle with a handſpike?" "No, no, (ſaid he) mind your work, I will cloſe that myſelf." They continued heaving in ſtones, and preſently ſhe ſunk gradually down, with her ſtern ſomewhat foremoſt.

His patron beheld the ſpot from whence he vaniſhed with a penſiveneſs that ſeemed to forebode to his mind an evil omen, and a ſolemn ſilence ſeized all the witneſſes of the extraordinary and awful ſight.

In a few minutes after his departure the water on the ſpot became greatly agitated; but various are the accounts of this; ſome of the men told me it was like a kind of an eddy that always enſues on the ſinking of any thing; but Mr. Blake thinks it was attended with a violent ebullition of air.

They watched carefully if any of the buoys, as ſignals, ſhould be ſent up, but none appeared; and anxiety grew great as the time approached which determined the fate of this unfortunate man.

The veſſel being miſſed by accidental obſervers, the news was ſoon propagated that Mr. Day was ſunk; in conſequence of which the hills became lined with ſpectators of all ranks of people, in order to behold ſo extraordinary a ſight, as the riſing of Mr. Day with the veſſel.

Two o'clock in the afternoon of the day after ſhe was ſunk was the appointed time of his riſing; but alas! the whole night paſſed away in anxious expectation and diſappointment.

Lord Sandwich, who was then at Plymouth, was applied to. He ordered all the aid which the dock-yard could afford, for weighing her up; three days paſſed under the continual endeavours of two hundred men, lighters, cables, and other requiſite materials; but in vain; he was left to be numbered amongſt the dead.

Before I proceed to deſcribe the different methods that were applied, as well by the orders of Lord Sandwich as my own endeavours in weighing up this unfortunate veſſel, I ſhall beg leave to inquire into the cauſes of the failure in this ſingular experiment; and hope, in the courſe of the inquiry, to advance ſome philoſophical truths, that may merit the attention of the curious, and point out ſomething that may be of farther utility.

A PHILOSOPHICAL INVESTIGATION OF THE FAILURE OF THE EXPERIMENT.

FROM the deſcription given of this ſingular veſſel, it may ſeem that the ſcheme might have been practicable enough; but if we inveſtigate the matter more philoſophically, and deduce our analogies from the experienced facts in nature, we ſhall, in my humble opinion, find that the plan was ſubject to failure from various cauſes.

The natural attributes of air and of water have been ſubjects much diſcuſſed by philoſophers both of ancient and of modern date: the inveſtigation of water was a favourite topic of the great Dr. Halley, whoſe ingenious Diving-Bell does him immortal honour; and the different qualities of air have employed the reſearching talents of our indefatigable Dr. Prieſtly, for whoſe numerous experiments the world is greatly indebted to the ingenious author. But with deference to thoſe great men, and others who have written on thoſe ſubjects, I am inclined to think, that they have not fully conſidered the effect which fire has on thoſe elements; or, in other words, the conſequences of *heat* and *cold*.

In the firſt place, the chamber ſeemed to be of ſufficient dimenſions to hold air enough for the experiment, as its area meaſured in the clear ſeventy-five hogſheads, or four thouſand ſeven hundred and twenty-five gallons; for ſince, according to the general allowance, a man conſuming a gallon of air in a minute, (being one thouſand four hundred and forty gallons in twenty-four hours, the time allowed for his ſtay under water) there would be three times the quantity abſolutely requiſite for his ſuſtenance.

But let us firſt remember, that the quality of air depends much on the temperature of warmth or cold in which it is breathed; for it is obvious, even to the meaneſt capacity, that the air in the ſummer ſeaſon is much more rarefied than in winter; and which may be farther proved by the ſimple experiment of filling a bladder with warm air, and immerging it in cold water; when the bladder will ſhrink conſiderably in its bulk.

It may then from this ſimple obſervation be a queſtion; admitting Mr. Day ſhut himſelf up in ſeventy-five hogſheads of air of the atmoſphere in a ſummer ſeaſon, (being the 20th of June) and deſcended with this into twenty-two fathoms under the ſurface, in ſo very cold a region, what ſtate, and what intrinſic quantity this chamber of air might be reduced to?

To me it appears probable, that the air with which he deſcended would be ſo diminiſhed by the cold of the circumambient water at that great depth, as to render the chamber comparatively a vacuum; add to this, that the warmth of a ſingle perſon muſt have been ſo far from counteracting the prodigious chill that on all ſides ſurrounded him, that he muſt, as it were, have been thunderſtruck with cold at the end of his fatal and ſudden deſcent; ſo as to exhauſt all vivifying warmth of the animal automaton.

That the unfortunate man imagined quite the contrary, is evident from his pulling off his coat and waiſtcoat, and ſaying, He believed he ſhould have a hot birth of it: he would moſt undoubtedly have had ſuch, if he had remained in the ſame atmoſphere in which he ſhut himſelf up, or deſcended no lower than in his former experiment, where he let only the tide flow over him; but he had no conception of the prodigious cold of the region he ſo precipitately was voyaging into.

The obſervations of the great Dr. Halley, when he himſelf deſcended in his Diving-Bell about ten fathoms under water, ſtrengthens me in my opinion: obſerving the ſudden condenſation of the air from the preſſure of the water under the bell, he ordered a very ſlow deſcent, until he might become enured to the cold and condenſed air. He alſo took notice, that the barrels of freſh air ſent down to ſupply him were ſenſibly cold, and greatly diminiſhed in their quantity; ſo that he found a much greater conſumption of air neceſſary than what he firſt imagined.

It is alſo a general obſervation, that there are more expert divers in the warmer climates than in the more northern; but what puts the reaſon of this difference beyond all diſpute is, that the very ſame divers, who in the torrid zone have deſcended to fifteen fathoms of water, come up half killed with chill at deſcending to four or five fathoms in the northern climates, even in ſummer ſeaſons too.

In the Weſt of England was a famous diver, who contrived a machine, which in fact was very ingenious; it was a tub containing ſomewhat more than a hogſhead; it had boots for his arms, and a window to give him light; the machine was wideſt at bottom and narroweſt at top, and ballaſted with lead in ſuch a manner as to deſcend obliquely, ſo that the diver laid ſomewhat declined upon his face, by which he had moſt command of his arms and ſight: in this kind of tub the diver ſhut himſelf up when he deſcended, and though he would remain in that quantity of air (being above a hogſhead full) for a conſiderable time in the atmoſphere he ſhut himſelf up in, or juſt below the ſurface of the water, yet when he deſcended about four, five, or ſix fathoms, he was not able to remain above five minutes, as his breath would ſeem to be exhauſted, and the preſſure on his arms became ſo violent, as to render him unable to work. At every time he came to the ſurface he was almoſt made ſpeech and motionleſs with chill.

We will now proceed to make remarks relative to the ſtrength of the chamber. Although every precaution ſeems to have been taken in rendering the chamber of ſufficient ſtrength to reſiſt the preſſure of the water, it appears to be the general opinion that this building muſt have been cruſhed; and that this has been its fate, is very probable, notwithſtanding all its ſtrength; but from what cauſe is the queſtion here in conſideration.

Was this preſſure owing to an increaſed denſity of the water at that depth? or, might it be occaſioned by the prodigious weight of that great column of water? or laſtly, might it not be occaſioned by the air in the chamber becoming contracted and ſo diminiſhed as to make a comparative vacuum, and by this contraction invite the circumambient refrigerated, conſequently condenſed water to ruſh violently upon him, ſimilar to an exhauſted phial being cruſhed by the circumambient air?

With reſpect to the firſt queſtion; I will readily admit that the water becomes condenſed as it deepens; but I cannot acquieſce, that this condenſation is owing to the weight of the bulk or column of water it ſuſtains; for if we conſider, that art was never able to force that fluid into a diminution of its bulk, though the moſt powerful experiments have been attempted by the Florentine philoſophers, namely, by compreſſing water in a golden ball, we muſt naturally conclude that a preſſure of the ſame fluid muſt be equally ineffectual; and in this particular it is characteriſtically different from air, whoſe bulk may be ſo ſenſibly diminiſhed by condenſation, even ſo much, that a hogſhead of air may be forced into a pint; from this quality of the air we perceive the great difference in the atmoſphere, being denſeſt as it approaches the ſurface of the earth; but ſhould the ſea become condenſed in the ſame proportion, its ſpecific gravity would doubtleſs increaſe ſo powerfully, that lead would be ſuſpended even at thirty or forty fathoms depth; which however we are well convinced, is not the caſe. But as a ſtill farther convincing proof, Dr. Hales curious Sea-gage would never have meaſured ſo great depths as we are well convinced it has.

The ſecond queſtion will appear to be built upon a philoſophical error even more groſs than the former, although it is generally adopted; namely, to attribute the preſſure to the weight of the column of water above. That thirty-three feet of water may be equal to a whole atmoſphere, is a principle which may anſwer to experiments in hydraulics, as far as relates to the riſing of water above the ſurface of the earth; but with reſpect to the nature of that fluid, when beneath the ſurface, it muſt naturally loſe all ſuch relation to the atmoſphere with reſpect to preſſure in any particular direction, and preſs on all ſides alike, and that in proportion to the reſiſtance of the medium occupying the vacuities not filled with the ſame fluid.

If the preſſure of the water ſhould be from the upper column of water ponderating downwards, equal to its weight, as if that column of water was collected into one quantity, the effect would appear the ſame as if the object was under the preſſure of the ſame weight of ſtones; and a log of wood would be no more able to make its way to the ſurface, than if it was buried under a heap of rubbiſh. But the propoſition itſelf is incompatible to common ſenſe and the nature of things; for fiſh will continue their courſe with the ſame freedom at the bottom of the ſea as on the ſurface, and feel no more of the preſſure than we of the air, though we calculate the preſſure of the atmoſphere to be nearly fourteen tons weight on our bodies. Let us therefore ſearch for another cauſe of preſſure, and ſee what the third queſtion will produce; namely, whether the preſſure of the water is not circumambient in proportion to its depth; and whether this preſſure depends not wholly on the degree of cold or condenſation of the air which reſiſts that preſſure, without having the leaſt dependance either on the water being condenſed, or the weight of the above column of water.

To the obſervations I have already advanced, I ſhall here add one from my own knowledge of the fact. In the icy part of the northern ſeas, I have obſerved that ice will aſcend to the ſurface, or ſink beneath it, according to the temperature of the weather. When the weather is in ſome degree mild, flakes of ice will gradually vaniſh and ſink into the deep; but on the contrary, in cold weather again, pieces of ice will ſpontaneouſly ariſe, which will even be covered with mud, that bear evidence they have been at the bottom. Whence does this ariſe? Doubtleſs from thoſe natural cauſes, that the water by a mild temperature of the weather will be rarefied, and therefore becoming ſpecifically lighter than the ice, cannot ſuſtain it; but on the contrary, in cold weather, the water becoming more condenſed, will conſequently be ſpecifically heavier than the ice, and therefore cauſe it to aſcend. It may however be here objected, that ſince condenſation, and conſequently an increaſe of ponderoſity, is the effect of cold, ice would become the heavieſt: but to obviate this, we muſt firſt remember that ice is produced from the ſurface of the water, the moſt rarefied part of the whole column, and which in the act of a freezing coagulation becomes diveſted of its ſaline particles, the interſtices of which becoming filled with air naturally muſt make it lighter than if all its component parts were united into a ſolid maſs.

Every one knows the old experiment of a corked bottle let down in a great depth of the ſea, becoming either filled with water or burſt by the preſſure.

Though this famous experiment has ſucceeded with ſome, others have tried it without that effect, and have denied the validity of the aſſertion. If in the northern climate, and in cold weather, a bottle is corked in a warm cabin by the fireſide, and let down with ſufficient weight to ſink it ninety or one hundred fathoms, the experiment will ſucceed; the cork will either be forced into the bottle, and it will be filled with water, or the bottle will burſt; but the ſame effect will not be produced between the tropics, except the bottle has previouſly been expoſed to the heat of the ſun when it was corked. But we may make experiments ſimilar to this, more ſatisfactory as to the cauſe, without going ſo far from home. Take two large phials of equal bigneſs, heat them by the fire, by which the air within them will become rarefied; cork them, and cut off the cork cloſe to the mouth; let there be two large veſſels of water, ſuch as upright butts, one filled with cold well-water, and the other ſomewhat warm; provide each phial with weight and line, and immerge them both at the ſame time; we then ſhall find, that the phial immerged in the cold water will either be burſt or be filled, whilſt the other will undergo no ſuch alteration. Again, take two ſuch phials and fill them with cold or condenſed air, and we ſhall find the cork will be drove out of the phial with a degree of violence which was let down into warm water, becauſe the air becomes more rarefied.

I think then from what I have advanced it ſeems demonſtrable, that the preſſure of the water muſt, firſt be circumambient, without having the leaſt difference in any direction, but is every where alike. Secondly, that this preſſure does not depend on the depth, but on the coldneſs peculiar to ſuch a depth, conſequently in proportion to the denſity of the air which cauſes the reſiſtance. And Thirdly, That the ſpecific gravity of water, or the denſity of that medium, does not increaſe with its power of preſſure, or in any-wiſe is depending on the weight of the column above it; as it is not a fluid elaſtic like air, and can ſuffer no other condenſation or rarefaction than from the effect of heat or cold, and therefore will never arrive to that degree of ſpecific gravity as to come in equilibrium with metals; except it ſhould petrify, in which cold has a conſiderable ſhare.

This then brings me to a concluſion on this head; namely, if it has ſo happened, that the chamber has been burſt in by the preſſure of the water, the violence could neither proceed from the denſity of the water at that depth, nor from the weight of the column of water preſſing upon the object; but from the prodigious coldneſs of the circumambient water, contracting the incloſed air in the chamber, ſo as to render it comparatively a vacuum, not only unable to reſiſt, but even by an attractive force to invite the circumambient cold and condenſed fluid to preſs in its walls, ſimilar to an exhauſted phial in the receiver of the air-pump when the air is let in, which, on account of the vacuum within, is cruſhed by the weight of the atmoſphere.

I am however inclined to believe, that the chamber was ſtrong enough to reſiſt the preſſure, I mean with reſpect to a violent cruſhing or breaking any part; but eſpecially if the veſſel had ſunk, as it ſeemed to be intended; namely, in being ſuſpended from the bottom by the ballaſt which was flung below her keel, and conſequently would have reſted on the ground. But the unfortunate adventurer finding, at the appointed time of his deſcent, that his external ballaſt was inſufficient to ſink him, had recourſe to a remedy to prevent a diſappointment of his enterprize, which could never have been contrived better to prevent his ever riſing again, if the whole plan had otherwiſe been ever ſo well concerted.

He was determined to ſink at that very time, at all events: whether this precipitation was occaſioned through a thirſt of gain, which might be depending on this circumſtance; or ariſing from a deſperate temerity, rather to hazard his life than to ſubmit his ſcheme to the cenſure of an amendment of the plan now ripe for execution; or whether his fondneſs for the exploit had perſuaded his ſanguine expectation, this matter was of no moment; certain it is, that the leaſt ſerious reflection muſt have condemned this laſt ſtep, ſo glaringly his ruin. For how compact ſoever this receptacle of air was put together, yet as its tightneſs depended on the ſeams of the planks; add to this, that two of the veſſel's beams went through the chamber; it muſt have been very imprudent to ſhake the veſſel by heaving into it ſuch a large quantity of ſtones; as it muſt doubtleſs have ſhaken the whole frame, and diſpoſed it at leaſt to leakage. But admit even this would be of no conſequence; a veſſel thus filled with ſtones, being top heavy, and carrying a weight within ſuperior to the external ballaſt, muſt doubtleſs have come plump to the bottom, with a ſhock enough to ſhake every part of her; ſo as not only to open the already ſhaken ſeams of the chamber, but to moor her home to the bottom ſhe fell upon.

Admitting however his chamber ſhould continue entire, and he ſhould even have ſurvived his appointed time of riſing, (which ſeems almoſt impoſſible) how horrid would be his fate in finding himſelf diſappointed of riſing upon diſengaging his ballaſt!

For ſince the external ballaſt was but twenty tons, and the veſſel loaded with thirty tons; may we not reaſonably ſuppoſe, that the upper work of the veſſel would become ſo water-ſoaken

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as to counterbalance the want of external ballaſt; and could it be poſſible, that the air-chamber of eighteen tons, could raiſe thirty tons, the quantity of ſtones in her hold?

Here then, according to this philoſophical inveſtigation, we ſee the many rocks on which this unfortunate adventurer has been expoſed to ſplit.

In the firſt place, he was poorly provided with a ſufficiency of air to breathe in for twenty-four hours; for it is not ſo much the quantity as the exchange whereon the ſubſiſtence depends; ſince by repeated experiments it is well known, that the expectoration of the breath of the animal itſelf renders it ſo noxious, as to deſtroy life without diminiſhing its real quantity.

Secondly, the atmoſphere of a ſummer ſeaſon was too rare an air for the cold region in which he deſcended, whence the air being contracted, muſt even have exhauſted his own breath.

Thirdly, the cold region, which he precipitately deſcended into, muſt have probably chilled his whole maſs of blood into an immediate coagulation.

Fourthly, beſides being very ill equipped for his deſcent, with regard to various circumſtances, his contrivance of diſengaging his ballaſt muſt have expoſed him to the greateſt peril; for having four bolts to diſengage (whoſe ſcrews, perhaps being ruſty, from the ſmall leakage unavoidable) it appears very probable, that the water ruſhing through the leaden pipe at the firſt bolt being diſengaged, would come with ſuch an impetuoſity as not only to hinder his driving in the internal plug for ſome time, and inſtantaneouſly extinguiſh his feeble light, but overwhelm him before he might be able to grope out his other ſcrews*.

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* We muſt not ſuppoſe however, that though the water would at firſt ruſh in with a great impetuoſity, the chamber would be wholly filled with it; for the aperture being at the bottom, the ruſhing in of the water would naturally condenſe the air, which at length would reſiſt ſufficiently to prevent any more coming in, and the upper part of the chamber muſt remain filled with condenſed air.

Fifthly, light by the help of a wax taper was a poor contrivance; ſince it is well known that a candle will require the ſame quantity of air to ſupport the flame as will ſuſtain the life of a man: beſides, light might have been procured by a much eaſier method, that would not have contaminated the air.

Laſtly, the three different buoys he meant to ſend up as ſignals, would indeed have been ſpecimens of true courage (which never takes leave of prudence) had he alſo provided means for aid, if he ſhould have wanted it; but ſince they were bare ſignals of fortune or misfortune, without any proviſion for the latter, we cannot deem them otherwiſe than premeditated preſumption: no ſignals appeared; I believe if any had, it would have been the ſignal of diſtreſs; but where was the remedy? the beſt would have been too late.

What I have here advanced is not with an intent to improve the plan, as it is to be hoped it will be the laſt of the kind for the purpoſes intended.

But as it is the duty of a true philoſopher to render his inquiries beneficial to ſociety, I have (ambitious of that character) ſcrutinized the more into the failure of this experiment, in hopes my obſervations may be taken as hints to future advantages.

In the mean time let us do juſtice to the memory of this unfortunate man; his ſcheme had certainly a ſpirit of ingenuity, and conſidering that he was illiterate, the invention was undoubtedly very great.

What other faults we find in his character, let us carry them home to our own breaſts; this will not only teach us to mend our own foibles, but to look with charity on thoſe of others.

THE

METHODS EMPLOYED

FOR WEIGHING

THE

DIVING VESSEL.

HAVING thus finiſhed my deſcription of this extraordinary veſſel, and philoſophical diſquiſition of the failure of the experiment; it remains now to proceed to the various methods employed in weighing her, as far as relates to my own laborious and expenſive endeavours.

I muſt beg the indulgence however previouſly to acquaint the reader with my motives for ſuch an extraordinary taſk which I undertook, ſeemingly ſo very foreign to the ſtation of life I fill.

I had two objects in view; the firſt was a philoſophical probability of reſtoring life to a man, whoſe death I preſumed not to be real, but a mere ceſſation of the animal functions, and whoſe congealed maſs of blood would remain a conſiderable time, in ſo cold a region, before a chance of putrefaction could take place; add to this, that he was ſecure from becoming food for the fiſh:

and having been fortunate enough to reſtore to life perſons that have been drowned, (the method of which I have fully ſtated in my Seaman's Medical Inſtructor) I own that my ſanguine expectations were flattered, notwithſtanding the length of time he had remained in this ſuſpence, ſince we have had inſtances of ſome extraordinary recoveries, with circumſtances leſs favourable than here.

My ſecond motive was, the pleaſure of clearing up to the philoſophical world, the true cauſe of the failure of this experiment, and to diſcover ſuch facts as might prove of future advantage to the world.

With thoſe views therefore I reſolved to offer my ſervice, after hopes of recovering the veſſel were given up by thoſe whom Lord Sandwich had ordered to employ their utmoſt endeavours in the taſk.

For ſuch an undertaking I thought myſelf in a great meaſure qualified, as I had formerly for ſome years, though in the capacity of a ſurgeon, made myſelf ſo well acquainted with maritime affairs as to be fortunate enough to contribute to the improvement of navigation, as well with reſpect to the mechanical as the ſcientific part of that art; add to this, that the many hardſhips I had experienced during my ſtation on that fluctuating element, had rendered me hardy enough to ſuſtain the fatigue I might reaſonably expect to undergo.

But wholly unacquainted with the true ſtate of this affair, (news-paper reports being ſo very fallacious) I wrote to a gentleman on the ſpot, ſetting forth my intentions and motives, requeſting of him the favour to give me ſome information relating to this affair, and to propoſe my offer to the parties concerned; in conſequence of which, I received, by the following poſt, this anſwer:

SIR,

AS ſoon as I was favoured with your letter, I communicated it to Mr. Hunn, who conſtructed the veſſel, and incloſe his anſwer for your peruſal and ſatisfaction. You ſee by it where Mr. Blake lives, to whom you ſhould apply. I heartily wiſh you ſucceſs, and indeed, from your known abilities, I have no doubt of it. And that you may not be foiled, permit me to obſerve, that your ſcheme may be facilitated, if Mr. Blake, or you, were to get an order from the Admiralty for the people of the dock-yard to furniſh you with materials and help, otherwiſe ſome obſtacles may be thrown in the way by thoſe whoſe ſkill, ſince their unſucceſsful attempt in this way, has been called in queſtion. I therefore mention this, that you may guard againſt every impeding circumſtance. If I can be of any farther uſe you may command me.

I am, SIR,
July 14th, 1774. *Your moſt humble ſervant,*

The copy of my letter to this gentleman being ſent by Mr. Hunn to Mr. Blake the ſame poſt, I received from him the following:

SIR,

IN conſequence of a letter you wrote to Mr. Hunn at Plymouth, offering your ſervice to get up the ſhip, I hereby inform you, that if you have a mind to try to effect it, and that it proves ſucceſsful, you ſhall have her for your reward, after I have examined the work, and the cauſe of the failure of the experiment.

I am, SIR,
Welbeek-ſtreet, *Your moſt humble ſervant,*
July 17, 1774. *CHARLES BLAKE.*

Accordingly I waited on Mr. Blake, communicated to him the letter I had received from my correſpondent, and the plan I propoſed for the operation. But as he declined applying to Lord Sandwich for any farther aſſiſtance; I reſolved to write to his lordſhip myſelf, which accordingly I did, and received the next day the following anſwer:

Admiralty, July 20, 1774.

SIR,

I Muſt beg to be excuſed from concerning myſelf in any ſhape about the veſſel that was ſunk at Plymouth; while there were any hopes of ſaving the life of the unfortunate man who ſunk in her, I was ready to lend every aſſiſtance in my power, but as ſoon as that became deſperate, my interference ended.

I am, SIR,
Your very humble ſervant,
SANDWICH.

I returned his lordſhip my thanks for his polite anſwer; at the ſame time communicated to him the philoſophical probability of yet reſtoring life to this unfortunate man; and gave alſo my intended plan for raiſing the veſſel.

Having therefore regulated my affairs at home, I ſet out from London, Tueſday morning July the 25th, and arrived at Plymouth the 28th, in the afternoon.

The day after my arrival I had the honour to be introduced to Admiral Amherſt, and Sir Frederick Rogers the commiſſioner, and acquainted them with the deſign of my journey. But on mentioning the contents of Lord Sandwich's letter, they alſo politely declined giving any farther aſſiſtance; which however, as a natural conſequence, I did not receive as a diſappointment; but without loſing time, I bent all my thoughts to the taſk I meant to undertake; and here lay before the reader an extract of my journal, reſpecting my various manœuvres, from the beginning, till I was obliged by frequent diſappointments to deſiſt from my operations.

The firſt object was to find the veſſel. This was repreſented to me as no ſmall difficulty; it being imagined, that when the king's people loſt her, ſhe was tumbled down a ſteep deſcent amongſt the rocks, and that ſhe had ſince been ſearched for, but in vain. Nevertheleſs, though I could receive no information, farther than a general idea where ſhe had been ſunk, and where ſhe had been loſt again in the endeavour of raiſing her, I prepared for a ſearch; and accordingly on Saturday the 30th of July I executed my firſt operation as follows.

I procured two boats manned, with about one hundred fathoms of cordage, inch and half; a lead and line; as alſo a marine ſearcher (of my own contrivance) being an iron, ſomewhat like a ſounding lead, but with a ſharp ragged ſpike; which being let down by its line, I might be able to diſtinguiſh wood from ſtone, *&c.* I took alſo to my aſſiſtance an experienced trawlman, accuſtomed to ſweeping. Being thus properly equipped, we went away, and came to the place about three o'clock in the afternoon, at low water.

We firſt ſounded all about the Bay, where we preſumed our object might lie, in order to obtain ſome knowledge of the ground, and then we proceeded to the operation of ſweeping; and being brought up by the ſweep upon a large object, we ſent repeatedly down our marine ſearcher, with which we fetched up at every time either ſome ſplinters of freſh wood, pitch, tar, or red paint; this, together with other circumſtances, ſeemed a confirmation that

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our object was the real one we were in ſearch of; eſpecially as there was no other veſſel ſunk in that part. But to put our ſucceſs beyond doubt, we ſwept the contrary way to what we had done before, and brought up upon the ſame ſpot; and by the help of our marine ſearcher, with which we even diſcovered the ſundry parts of the veſſel, we concluded with certainty that our operations had had the wiſhed-for ſucceſs.

We found her in twenty-two fathoms low water; about one hundred and fifty fathoms off the main ſhore; St. Nicholas's Iſland, bearing due South; Fire Stone Bay North by Weſt.

Around the object was a ſoft clayey mud; about twenty fathoms towards the main ſhore ſteep aſcending rocks; towards Mount Edgcumbe an aſcending ſandy and clayey bank; towards the Hoe and Milbay a deep muddy rocky channel; and towards the iſland a gradual aſcending ſandy and clayey bank.

When I had taken my proper land-marks, I ſecured my ſweep with a grummet; ſunk a ſmall buoy ten fathoms under water, and ſunk the looſe ends of my ſweep, ſo that coming to the place they might be eaſily found with a creeper; and we retired ſatisfied with our firſt day's ſucceſs.

The following Monday morning, being the 1ſt of Auguſt, I began my preparations.

I provided two barges, each of forty tons; I laid in them a platform, or temporary deck, that the people might work with eaſe and ſafety.

Over the gunnels of theſe barges, about one-third from ſtem and ſtern, keeping them about ſix feet aſunder, I laid a pair of Spaniſh windlaſſes, made out of two top-ſail-yards, about ſeventeen inches diameter in the middle, and forty feet long; theſe windlaſſes being battened and holed for common handſpikes and purchaſing handſpikes, and ſtrengthened with iron hoops betwixt the holes, I ſecured them in proper chocks on the gunnels of the barges.

I ordered alſo two hawſers of ſeven inches circumference, and ſeventy-five fathoms long, together with other cordage and blocks, for the various implements I might require; as loff-tackles, jigers, ſelvagees, &c.

In the mean time, whilſt my barges were fitting out, I had a quantity of my ſpiked blocks made, and a rammer of peculiar conſtruction, which I had contrived ſome time before, when I had thought of a new method to weigh a ſhip ſo ſituated, as to render ſweeping impracticable; for example, if ſhe ſhould be jammed in between rocks. The contrivance was as follows; a ſingle eight inch ſhivered block was bound in a ſtrong iron ſtrop, to which was a long bearded ſpike, ſo as to have a great hold when faſtened into the timber of the object that was to be raiſed. Theſe blocks were to be reeved with an inch and half rope, ſo that the ſpike ſhould point downwards; and that the block might not cant whilſt it was under water, they were provided with ſmall iron loops on the ſide, that would always keep them clear in the reeving.

The next implement was a rammer, with which the blocks were to be driven into the object. This was a ſtout bar of iron about four feet long, and about fifty pounds weight; at the top was a ring to hold the ramming rope; below, it was ſomewhat flat to act upon the ſtrop of the block; above and below were eyes on each ſide, through which went the rope that reeved the block, in order to guide the rammer that it might ſtrike perpendicular upon the block; but as the rope that held the rammer would be ſubject to twiſt, if it was made in the common manner, I contrived one which was platted of four lines, which prevented its twiſting, ſo that the rammer might be ſent down and hauled up again without danger of twiſting.

By theſe blocks rammed into the object, I meant to haul down (with each block) an empty caſk, and thereby to facilitate the raiſing of the veſſel.

My conſtant crew conſiſted of a trawlman, a boatſwain of a man of war, ſix able ſeamen and four bargemen belonging to the crafts. The trawlman and boatſwain I appointed officers in their peculiar ſphere of action; the reſt as foremaſt-men, were ordered to obey the commands given by them or myſelf.

Our preparations were got ready with ſo much expedition, that we fell down from the pool and went to work the following Wedneſday, Auguſt the 3d, at four o'clock in the afternoon.

We ſwept our veſſel with both our hawſers, brought them to our windlaſſes, and hove down the ſame tide.

This operation was effected in the following manner. In the firſt place it muſt be obſerved, that whilſt we were preparing in the pool, our barges were obliged to lie along-ſide each other; but when we were ready to fall down, one of the barges took the Spaniſh windlaſſes on board, ſo that each barge went away ſeparately.

When both barges were moored to the king's buoys in the channel, we prepared for ſweeping, thus; ſending previouſly a boat away with a creeper, we took up our ſweep that was laid on the Saturday when we found the veſſel; and the boat with that ſweep was brought up and down upon the object, to determine the ſpot. In the mean time two boats were made ready with the large ſweeps, *viz.* one of the hawſers, to the ends of which was bent a rope of fifty fathoms, which was coiled one half in each boat. Then, as the boat that had on board the ſmall ſweep and was laying up and down upon the object, and having alſo in ſome meaſure determined the Saturday before the manner that probably the veſſel laid with ſtem and ſtern, we began our operation from ſouth-eaſt and north-weſt; theſe boats therefore with the ſweep being brought about thirty fathoms north-weſt from the object, a large ſtone was put to the bite of the hawſer; then it was hove; the hawſer in both boats paid out, whilſt the boats rowed gently abreaſt of each other, till the end of the hawſer, to which was alſo another ſtone, was paid out. When the hawſer was ſunk to the bottom, each boat was ordered to row with all their ſtrength, till the ſweep was brought home to the object.

Then one of the barges was warped away to receive the ſweep; and having moored her firſt well a-ſtern, the ſweep was well hove home to the object by the barge windlaſs; then a jewel, well parcelled, with about one hundred weight of ſtones together with a meſſenger or jewel-rope, was let over the hawſer and run down in order to jam the ſweep. In the mean time, while this was doing, the boats were preparing with the other hawſer, and in the ſame manner as before the ſweep was laid on, and taken on board the other barge; hove home, and the jewel run down upon the ſweep as before.

When the ſweeps were ſecurely laid on the object, the barges hauled along-ſide each other, and the windlaſſes were laid in their chocks; the ſweeps were brought to the windlaſſes fore and aft, and all hands ſet about heaving down.

But while we were thus employed, the wind ſhifted to the ſouthward; a heavy ſea began all on a ſudden to tumble in, and a thunder ſtorm aroſe, which obliged us to ſlacken our ſweeps, and a terrible night we had of it; and had we not been ſecured by one of our ſweeps on the wreck, we muſt inevitably have been drove upon the rocks; as the anchor and cables belonging to the crafts were not calculated for the depth of the water and the preſent ſituation we were in.

Near two days paſſed away with bad weather, before we could diſengage our ſweeps that were brought into confuſion, and before we could come into order again.

The hawſer by which we had rode in the hard gale was conſiderably ſtretched and chafed by the wreck.

Friday, Auguſt the 5th, in the afternoon, the weather clearing up, we went to work again; we ſwept our object, hove down at low water with an intent to ſtretch our hawſers, and gradually to draw the object out of the mud. In the mean time I tried the operation of my ſpiked blocks; but though the mechaniſm anſwered to my expectation, yet the under current of that great depth of water in this muddy whirlpool diverted my implements from the object, ſo that I ſaw it impracticable to fix them with any certainty; I therefore laid them aſide, and purſued the plan that ſuited beſt to circumſtances *.

On Saturday the 6th we hove down again at low water; we belayed our hawſers around the maſts and beams of the barges, and ſecured them with loff-tackles, *&c.* and waited the event of the tide, either to break our gears, or elſe to tear our object from her bed of mud.

When our barges were down fore and aft to thirty tons a piece, our windlaſſes were bent prodigiouſly, and I ſuſpected they would break; I ordered therefore every man to his ſtation, commanded ſilence, and to watch carefully my orders. In leſs than five tons ſtrain more they both broke, and the hawſers were rouſed up and payed out in a moment; but had there been the leaſt confuſion, our crafts would inevitably have been overſet, for the maſts of the barges began to croſs each other, and the water was entering the inſide gunnels.

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* The greateſt objection my philoſophical friends made to the plan of this mechaniſm was, that they apprehended my rammer would not act with a ſufficient force through ſo denſe a medium as they ſuppoſed ſuch a depth would be: experience however proved to the contrary; for a few blows knocked one of the blocks quite faſt; and another was broke off about an inch of the ſpike by an accidental defect of its temper. Though the under-current of this place made me decline the purſuit of the plan here, yet every action anſwered ſo much my previous expectations, that I am perſuaded it may tend to great utility in future on other occaſions; which I ſhall take a more pertinent opportunity to lay circumſtantially before the world.

In leſs than two hours our windlaſſes were replaced with two maſts, ſixty feet long, and about twenty-two inches diameter at the thickeſt end, together with two ſpars to laſh to them, if neceſſity ſhould require; theſe maſts were battened, holed, hooped, and turned into windlaſſes: the next day's tide, being Sunday, Auguſt the 7th, when we hove down again at low water, belayed our hawſers as before, and laſhed our ſpars a top of the windlaſſes; but when our barges were ſunk to about thirty tons a piece, the hawſers ſweeted and ſtrained prodigiouſly, and I apprehended another accident; I therefore obſerved the ſame regulations as before; one broke, and we got clear of the threatened danger with expedition and ſafety *.

I ordered immediately two eleven inch hawſers ſeventy-five fathoms in length, which were finiſhed and ſent on board in leſs

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* About an hour before this accident happened, miſſing the ſtep in my frequent running between the barges on a plank that was laid for that purpoſe, I fell headlong over-board; but through a providential preſence of mind, as alſo the agility of my people's aid, I came ſafe on board, though the current went with great rapidity; and, without ſhifting my cloaths, purſued my work without the leaſt impediment to my mental faculties or health.

I mention this circumſtance for two reaſons; firſt to obſerve, that an habitual preſence of mind is the happieſt ſafeguard a man can have in every kind of danger; as I have farther expatiated on in my Seaman's Medical Inſtructor, page 89. And ſecondly, that a man is perfectly ſafe from catching cold by being wet with ſalt water, and more eſpecially, if he is not too much in a hurry of ſhifting: cloaths wet with ſalt water are far from being ſo uncomfortable as people imagine, beſides, it is the beſt kind of bath of all others, and highly beneficial in many caſes. It is quite the reverſe however with rain or freſh water. See the ſame book, page 104.

than two days, notwithſtanding during the whole time it was very bad weather †.

Wedneſday, the 10th, we ſwept our object again with the new hawſers; but one of our ſweeps miſcarrying, I ſatisfied myſelf with bringing our new ſweep to the windlaſſes; and ſupported the old one with a ſmall hawſer and brought it to the other windlaſs; we then hove down that tide, ſtretching our new cable.

Thurſday, the 11th, we ſwept again with the other new cable, but miſcarried; we hove down however with what we had. We ſecured our windlaſſes with iron palls, and laſhed the ſpare ſpars a-top of them; our hawſers were ſecured round the beams and maſts of our crafts as before, and waited with circumſpection the event of the tide.

When our barges were ſunk between twenty-five and thirty tons a-piece, they ſunk and roſe alternately, but not in proportion to the riſing of the tide, which I took to be a good omen; but at high water they roſe each fore and aft to twenty tons.

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† On the Tueſday, the 9th of Auguſt, over-hauling the hawſer that was broke, the fracture appeared ſo ſuſpicious, that ſome of the witneſſes could not help ſaying, the fag-end of the fracture ſeemed as if it was cut with a knife; but this was diligently attributed to the ballaſt bolts, or googings of the ſtern poſt, or ſome other part, the ſweep might have hold of. As this probably might have been ſo, I took no farther notice of it; but over-hauling more of the hawſer, I was not a little ſurprized in finding it actually cut into all the ſtrands, and the fracture covered ſlightly with two or three round turnings of a rope-yarn to hide the damage. Nobody however had done it; the accident was attributed to the careleſſneſs of the carpenters, but they (and I believe with much juſtneſs) reſented the falſity of the aſſertion. I had then ſome thoughts to ſhiſt all hands for a freſh ſet; but as every body on board declared themſelves equally uncapable of ſo great a piece of villainy, (to their generous maſter, as they were pleaſed to call me) I huſhed all into peace, ſtifled all ſuſpicions within my own breaſt, and purſued my work with as much confidence as before.

I mention this circumſtance as an inſtance, that a man may ſometimes be too delicate in his ſentiments; eſpecially when he has low and contracted minds to deal with.

I then ordered both our mainſails to be hoiſted, and guyed them right before the wind: (the wind being northerly towards the iſland, and a fine gale) It was attended with ſucceſs. We opened our landmarks, and went ſmoothly on towards the iſland about fifty fathoms, with our prize, to the great ſatisfaction of our numerous ſpectators. I was congratulated by many gentlemen preſent; but I ſaw too many difficulties remaining to receive it as deciſive.

My people however appearing in full ſpirits with this piece of ſucceſs, unanimouſly deſired me to purſue heaving down the next tide; and flattered themſelves that with additional hands they might heave the veſſel up bodily, and bring her high and dry, in leſs than twenty-four hours. I did not at firſt acquieſce with the motion, being averſe to purſue a work of that conſequence in the night; but on their importuning me, I conſented, (though not ſo ſanguine in my expectations as they ſeemed to be) but merely as I eſteemed their requeſt as the greateſt mark of affection they could give me.

I aſked two colliers ſhips crews to lend me a hand, who, together with their maſters, willingly gave me their aid*. We muſtered up that night about fifty able hands, and illuminated our barges ſo effectually with lanthorns, that our work was carried on with reſpect to light, almoſt as ſecurely, as if it had been day.

But as I was overcome with fatigue, and found myſelf very much indiſpoſed, (having, during the whole time, had the leaſt reſt of any man on board) I propoſed to retire into the cabin of the barge, to take a little nap till the tide ſhould riſe, that I might be refreſhed for the vigilance the approach of high water might require. In the mean time I ordered to heave down; but intreated my officers to ſpare the old hawſer, and to heave beſt upon the other ſpare hawſer that was to ſupport it; as on that circumſtance our fortune would depend. I retired; but what I feared came to paſs; in leſs than an hour I awoke with the noiſe of the ſurge; and running upon deck, was told the old hawſer had broke, (owing to a ſurge of the other old hawſer in holding on) and that we had loſt the veſſel again, to the great diſmay of my crew, who attributed the misfortune to my abſence.

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* This piece of friendly proffer proceeded from the honeſt ſimplicity of a true grateful heart, who publickly gave me his thanks for the benefit I had been to navigation by my READY OBSERVATOR. This book, I am happy to ſay, has procured me the eſteem of many a brave ſeaman.

As I would not harbour a thought that there was any deſign in this miſcarriage, attributing it rather to their precipitate eagerneſs, I cheriſhed them with the hopes of better ſucceſs, and ſent all hands to reſt.

Examining however in the mean time the force it would require to raiſe forty tons weight, and that our windlaſſes were not ſufficient for ſuch a purchaſe; I propoſed to erect two pair of ſheers from the kilſon of the barges, one pair to each Spaniſh windlaſs, and each pair to be ſupported with four guys; in each pair of ſheers I meant to ſling two pair of ten-ſhiver'd purchaſing blocks, and meant to bring my falls by leading blocks to the barge windlaſſes; and when my object was weighed from the bottom, then to get two hawſers under her keel, and bring them to the ends of my Spaniſh windlaſſes, according to my firſt plan. By this powerful mechaniſm I hoped to heave her up bodily to the ſurface of the water, at our next ſucceſsful ſweeps with both our eleven inch cables.

I ordered therefore the next morning this mechaniſm to be erected, which had been the fruit of my preceding night's ſpeculation;

culation; and which was purſued with ſo much alacrity that the whole was erected the very next day.

This being done, and having the day after ſwept my veſſel again, we were ready to heave down at low water on Sunday noon, the 14th of Auguſt. I muſtered up therefore fifty able ſeamen, the additional ones choſen colliers; (men of the greateſt renown for plying the rope and handſpike) and though the day turned out ſo bad, that we had not a ſingle idle ſpectator, we ſet to work with ſpirit, and ſucceſs promiſed greatly in our favour. The mechaniſm anſwered our expectation; we hove away chearly; the veſſel was actually from the ground, when behold an unlucky ſlip of one of my hawſers in fleeting, in the department of my boiſterous boatſwain, gave the affair an unſucceſsful turn; the ſweep ſurged, and we loſt the veſſel again.

Bad weather enſued, which laſted for four days, and was ſo tempeſtuous that it wearied us out with our inceſſant endeavours in keeping our craft from driving upon the rocks; I had ſecured all however with two ſtout anchors and cables, by which we moored ourſelves, wholly diſengaged from the wreck. The ſea tumbled in very heavy; and the ſheers (againſt all expectation) were a great ſteadiment to us, by which the barges rode peaceably along-ſide of each other; which without them would have been wholly impracticable.

Wedneſday, Thurſday, and Friday we ſwept again and again; but all was labour in vain. I perſevered however in my work, ſwept my object on the Saturday, and hove down the following Sunday, the 21ſt, but miſcarried again as before. Bad weather again came on, and all our ſweeps diſengaged.*

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* On Monday the 22d, at the clearing of our foul ſweeps, we brought up one of the ſluice plugs, by which the unfortunate Mr. Day let the water into his veſſel; this was not

On Tueſday we ſwept her again, brought our ſweeps to the windlaſſes, hove down at low water, weighed the veſſel, and carried her about ten fathoms farther towards the iſland. But whilſt all went well, ſome unlucky blunder was committed, which diſengaged one of our ſweeps, and we ſeemed to have her right on end by the other.

In this unexpected diſaſterous ſituation of things, I ſnatched however the opportunity of putting into execution a deſign I had long premeditated, but hitherto had not met with a favourable conjuncture, *viz.* to tear away her external ballaſt; a very material impediment, as every ſtone might be conſidered as an anchor mooring her to the ground[*]. This operation I effected in the following manner; I ſwept with one of the old hawſers at high water, ſo that I was ſure it could have hold of no part but her ballaſt; then I took another round turn with the ſweep, and let the ſweep remain ſlack till low water; and having a large trawl-boat in my employ, I brought the ſweep to her bow, hove down at low water, belayed the parts ſecurely, and ſo let the riſing tide not only jam the hawſers round the ballaſt, but at the ſame time to tear it away by main force, (provided my hawſers ſhould be ſtronger than the ropes with which the ballaſt was ſlung;) the boat (about twenty tons burthen) gra-

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only a confirmation of our being engaged with the right object, but was in its recent ſtate a philoſophical curioſity, that proved an increaſed ponderouſity of the whole veſſel; beſides other phenomena of ſuch a depth of water. Though the wood itſelf of the plug had been a light pine, it was when brought up heavy like iron; and covered with a mucus, that was curiouſly interſperſed with the firſt rudiments of ſhell-fiſh of various kinds.

[*] I had many contrivances offered me for to effect removing this obſtacle, but however plauſible they ſeemed to be with a black led pencil, they promiſed nothing (except great expence and labour) if any of them had been carried into execution. There is a wide difference betwixt ſpeculation and practice, eſpecially in works of this nature; the ſimpleſt method is very difficult to execute.

dually ſunk her bow very deep. But near high water ſhe lightened with a ſudden jerk; the ſweep came clear, and from the marks of the bolts and other circumſtances it was evident that we had effected what we intended.†

And now it ſeemed after all this good ſucceſs we loſt the art of ſweeping as effectually as before. However, not diſcouraged by the various diſappointments I met with, I ſtill perſevered. But as my hawſers were worn almoſt out in many places, I reſolved to alter my plan, in hopes yet to accompliſh my wiſhes, with the remains of my materials; eſpecially as the method I meant to purſue would be much eaſier put into execution.

I ordered my large hawſers to be unlaid into ſtrands, and to ſplice them where they might be chafed or damaged; which was accordingly done.

The plan of my intended operation was this; I meant to lay on the object ſix different ſweeps of theſe ſtrands, in ſix different directions; each ſweep to be ſecured with a grummet, and then to ſend a jewel down to jam the whole; thus to cradle my object, and divide the ſtrands into different purchaſes. And when firſt I had weighed the object, to be ready with my hawſers, and bring them under the keel, and ſo ſecure ſucceſs to my deſign.

Having therefore made my people ſenſible of the plan, I began theſe operations on Friday, the 26th of Auguſt; and with much apparent difficulty we laid on that tide only two of theſe light ſweeps, waſting the ſame time that ſix might have been done in, had matters been executed with the ſame ſpirit and fidelity as at firſt.

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† On the clearing of this ſweep, we hauled up about thirty fathoms of ſeven-inch hawſer, which was left on the wreck when the king's people loſt her; this I ordered to be ſent to the dock-yard as part of his majeſty's ſtores.

To compleat my diſappointment, the evening brought us bad weather again; and the night was ſpent with a heavy ſtorm, rain, and a great ſea; which ſeemed likely to continue.

I therefore reſolved the next morning to deſiſt from my operations for that time, as my patience at length was worn out. Accordingly I ordered to unrig and return home.

When I had paid my men, it was then firſt that I diſcovered the ſtumbling blocks that had been thrown in my way to fruſtrate my ſucceſs; and ſuch, as it was high time (if not too late) for me to be acquainted with.

I prepared however for another attempt; and planned a method, which though more expenſive at the firſt coſt than the former, it would neither be ſo ſubject to accidents from the fluctuation of unſteady weather, nor ſo liable to be fruſtrated by private treachery.

But ſome of my materials requiring much workmanſhip, time elapſed very faſt; add to this, that the month of October produced very bad weather, which hindered ſome of the work going on.* Being however at length in full readineſs, I meant to execute my ſecond attempt on the 21ſt of October; but the morning of that day ſetting in with ſtorm and rain, I was obliged to retire a ſecond time, and ſet immediately out for London, eſpecially as my private affairs demanded my preſence.

I meant indeed to return to Plymouth to recommence my operation; but a concurrence of various circumſtances prevented my deſign from taking place. I regret my diſappointment only, as I had the cleareſt conviction in my own mind, I muſt have ſucceeded at laſt; and that my ſucceſs would have proved highly advantageous to philoſophical enquiries, and in many reſpects tended to benefit mankind.

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* For the particulars of theſe materials, and the plan of operation, ſee the latter end of the Appendix.

APPENDIX.

OBSERVATIONS

ON THE

VARIOUS METHODS

OF

RISING OF VESSELS IN GENERAL.

SUCCESS is the general criterion of merit, with the bulk of mankind; perhaps therefore it will be deemed by many a preſumption in me to offer to throw light on a ſubject, in which I have practicably failed.

But, though a reflection of this nature would damp the ardour of one whoſe ſole purſuit is fame, yet it ſhould in no wiſe diſcompoſe the man who is ambitious only to perform his duty; if he is conſcious his offer may turn out advantagious; ſhould even thoſe reap the moſt benefit, who are the leaſt diſpoſed to acknowledge the obligation.

With reſpect to my late failure, the cauſe muſt be obvious to the judicious reader; to add reflections is wholly beneath me; I therefore proceed to the ſubject in hand.

The difficulty of riſing a veſſel, unfortunately ſunk, is principally in proportion to the nature of the bottom ſhe is ſunk on, and the current of the tide on the ſpot; but it is not ſo much in proportion to the depth of the water, as people imagine. The ſuppoſition of the water preſſing on the object in proportion to the depth, is wholly erroneous. When the gears are firſt laid well on, the force requiſite, is equally the ſame in twenty or thirty, as four or five fathoms; but then to fix thoſe gears in ſo deep a water is the difficulty; add to this, that it requires a nice care and fidelity in the weighing operation.

With reſpect to the nature of the bottom, that I ſhall conſider under three different kinds, *viz.* rocky, ſandy, and muddy.

A rocky bottom, and more eſpecially in deep water, is certainly attended with the greateſt difficulty; (unleſs indeed the bottom is flat, and which is ſeldom the caſe) for not only the rocky hillocks are liable to catch the gears, and keep them from the object, but chafe and cut them all to pieces, and often renders a veſſel irrecoverable; eſpecially by the common methods.

A ſandy bottom is ſeldom what we would naturally ſeem to expect from it; ſand, by the continual agitation of the water, is capable to penetrate into the ſmalleſt crevice in a veſſel, like a driving ſnow, and fill the veſſel before one is aware of it, eſpecially if the place is continually ſwept by the tide; but on beaches where there is a conſtant ſurf, and an eddy from ſome headland or bay, a veſſel will be buried in ſand preſently, if immediate aid is not applied to.

A muddy bottom is however the beſt (few caſes excepted) for here a veſſel lies not only ſoft, and forms to herſelf a kind of dock, that keeps her ſteady from being toſſed about by the agitation of the water in tempeſtuous weather; but as a muddy bottom is ſeldom or ever ſwept forcibly by the tide, or liable to ſurfs, the veſſel remains as it were in a ſtate of reſt, and therefore not ſo ſubject to fill with mud. 'Tis true there will be a great coheſion, by means of the dock ſhe lies cemented in; and ſometimes will require two or three times the force of the weight of the veſſel itſelf to draw her out; a proportional ſtrength of the gears however and patience will counteract all this. But though a veſſel will not be very ſubject to fill with mud from the bottom ſhe lies ſunk in, yet ſhe is ſubject to be filled with mud from the ſettling of the water above her, more in ſuch a ſpot than in any other, and become ſo ſlippery, that on that account it will be difficult to fix the gears ſo as not to ſlip off.

The ſituation of the place, the courſe of the tide, as alſo the weather, are material objects to be conſidered. Open bays are ſubject to many inconveniencies from the ſwell of the water; for the gears will be agitated even on the bottom itſelf. On the other hand again, incloſed bays are ſubject to ſo irregular tides, that it will ſometimes puzzle the moſt experienced ſeamen to determine the ſetting of the current, inſomuch, that there will be three or four different under currents to the courſe on the ſurface (which is the caſe in the place where the diving veſſel was ſunk.)

With reſpect to the tide itſelf, no time for work is ſo proper as at low water; not ſo much on account of the difference of the depth, as the natural inactivity of the water itſelf; for though the ſurface may ſeem equally ſmooth at high as at low water, yet frequently at high water, when it is ſtill at top, the current will go underneath at three or four knots an hour, which muſt naturally render work uncertain.

With reſpect to the weather, a fair day ſhould always be choſen, if circumſtances will admit of it; and particular regard ſhould be had, that the wind is off the ſhore; as it counteracts the tumbling in the ſwell, natural to the main ſea; even a ſmart breeze from that quarter is highly preferable to a ſea wind, though it ſhould ſeem almoſt a calm; for though it may occaſion ſome turbulence of the water, yet the waves will be but ſmall and bubbling, and affect barely the ſurface, whilſt a ſea ſwell generally agitates the whole deep.

Rain becalms the ſurface of the ſea greatly; but the men not only work uncomfortably, reſpecting themſelves, but the gears are rendered ſlippery, the tackling works heavy, and thence ſubjects the operation to ſo many inconveniencies, that unleſs it is a caſe of emergency the operation on a rainy day ſhould be ſet aſide.

"In a multitude of counſellors there is wiſdom," but in the operation itſelf there ſhould be one ſole commander, whoſe ears ſhould be as quick as his eyes; and with a reſpectable calmneſs of temper, uſe no more words than what are worthy of attention. He ſhould have one or two officers to conduct his orders, but he ſhould be much more careful than I have been in the late affair on whom he depends, otherwiſe, notwithſtanding ſkill and diligence, he is ſubject to miſcarry.

He ſhould engage the hearts of his people, and he will have their labour into the bargain; but he ſhould be careful not to intoxicate them with a ſuperabundance of generoſity, as that is equally dangerous as ſuppreſſing their good inclinations by niggardlineſs. Men in habitual ſervitude are naturally inclined to be jealous juſtice is not done to them; whence they are too apt to look on generoſity as the effect of weakneſs or deſign.

In laborious employ it is requiſite that the paſſions ſhould be ſometimes rouſed; but to do it with ſwearing and a turbulent noiſe is not only fooliſh, and breeds confuſion, but creates ill blood in the beſt diſpoſed minds. The human heart has a natural averſion to force and ſlavery; but a reſpectable authority, intermixed with a chearful incitement, is a cordial to a labourer, winds up all his powers of activity, and creates an ambition to excel.

No more men ſhould be employed in a work of this nature than what are abſolutely neceſſary; operations have oftener miſcarried through ſupernumerary idlers, than a deficiency of hands. Nothing ſours a hard-working man's temper ſo much as to find his fellow labourer does not work ſo hard as himſelf. He can excuſe in his heart no man, except the principal maſter of the work. A judicious director therefore, if he is fortunate enough to have one or two brave and faithful men to put his orders in execution, and preſerve the reſpect of his people, may with eaſe and pleaſure make twenty men do more work, than an arrogant bluſterer with ſix times the number, notwithſtanding all his noiſe and tumult. It is not what men can do, it is the will, that ſets their powers into motion; will and fidelity may work wonders, much beyond what conſtraint and force are likely to perform.

When a veſſel is ſo ſituated, as to be partly or wholly dry at low water, it would ſeem that ſhe is eaſily weighed, as manual obſervations may be applied to the object itſelf; and the fact is ſo. But how often do we ſee ſuch an unfortunate veſſel either totally loſt or at beſt ripped down to the water's edge, and the remaining wreck either becoming a nuiſance to a harbour, or perhaps at beſt removed with much more trouble and expences than the whole hull might have been raiſed for.

I have often wondered why in this kingdom amongſt its many wiſe inſtitutions, proviſion for that kind of diſtreſs is more neglected than the well regulated and immediate remedies we have in caſe of fire. For my own part I humbly conceive, that if all the various materials for raiſing of ſhips, in whatever unfortunate ſituation they might be, were kept in readineſs, it would not only be the ſaving of much property to unfortunate individuals, but become of national advantage in general; beſides adding additional luſtre to public ſpirit.

The expences of ſuch materials would be greatly inferior to the advantages they might produce, eſpecially if they were ſupported by a ſubſcription of the merchants in each port, who might become partakers of the benefits accruing. Beſides, ſince underwriters ſtand partly in the ſame predicament as proprietors of fire-offices, would it not be their advantage to have an inſtitution of this nature ready for immediate relief?

I ſhall not dwell on the raiſing of a veſſel, that has all the advantages which ſuch an unfortunate ſituation will admit of; ſince in the ſequel, treating of ſuch as are more difficultly ſituated, it will be obvious what method in ſuch caſes is moſt applicable.

Three things are to be conſidered in weighing a veſſel, with reſpect to the hull itſelf.

Firſt, her ſituation as to ſtem and ſtern: Secondly, the nature of her cargo: And Thirdly, her burthen, age, and the accidents that ſunk her.

The ſituation of a veſſel as to her direction is eſſentially requiſite to be known, for the weighing of her. When the maſts and her rigging are wholly out of ſight, it is no ſmall difficulty; yet unleſs the bottom on which ſhe lies is very rocky, it may be aſcertained, *viz.* by laying on the object different ſmall ſweeps, the ends being kept tight by different buoys on the ſurface of the water.

The nature of her cargo alſo is of conſequence; for if it conſiſts much of dead weight in her hold, the upper work will be liable to ſeparate from her bottom, if the greateſt care is not taken to fix the gears low enough, which ſometimes is hardly practicable, eſpecially in a ſandy or muddy bottom, and more particularly if ſhe has remained there for any length of time.

Her burthen, age, and the accidents that ſunk her are likewiſe materially to be conſidered.

The larger a ſhip is, the more pieces ſhe muſt be compoſed of, and therefore ſhe muſt naturally be weak in proportion to her bulk. And though an old ſhip is often as ſtrong for ſervice as a new one, yet the timber will always become brittle, and therefore liable to receive damage from any unlucky blow, and for the ſame reaſon will be leſs able to ſuſtain the force requiſite to weigh her.

Having previouſly conſidered theſe circumſtances, we will proceed to the operation itſelf. The firſt difficulty is to find her, when ſhe is wholly out of ſight; this depends on the ſucceſs of ſweeping. But before that is begun, a knowledge of the bottom and depth of the water is previouſly neceſſary. A ſounding lead for that purpoſe ſhould differ from a common one in this; that it ſhould be flatter at the lower end, ſomewhat hollow, that it may contain plenty of tallow, and have a ragged ſpike about three or four inches long in the middle; by which the tallow would not only bring up ſomething of the mud or ſand of the bottom, but the ſpike in a ſandy bottom would poliſh ſomewhat; in mud it will be covered; but on rocks it will ſtrike hard, blunt the point, and ſave the tallow from being touched; and in wood it would naturally ſtick faſt. Thus it would ſerve as a marine ſearcher, and diſtinguiſh what it hit on, as well as aſcertain the depth of water.

The ſpot that is to be ſwept ſhould be carefully ſounded; to do this with preciſion, two boats, each with a ſingle pair of oars, ſhould go in company as cloſe as they can, ſo as to keep clear of one another; each with a lead and line as above, and rowing ſlowly on, keep continually ſounding; one boat heaving the lead whilſt the other is hauling her's up, and call to one another the depth of the water, whilſt proper notice is taken of the correſponding land-marks: but more eſpecially if they ſhould perchance find any object worth peculiar attention.

Sweeping for the veſſel itſelf is the next thing: this is beſt performed with an inch, or inch and half rope; for the ſmaller the rope, provided it is good and ſound, the ſurer is the operation. Care ſhould be taken that a rope has ſufficient length according to the depth of the water; from ten to twenty fathoms depth, it ſhould be one hundred and fifty or two hundred fathoms or upwards, according to the circumference you would ſweep. The weights put to the rope in order to ſink it, ſhould be ſpread according to the extent of the intended ſweep; for ſuppoſe the boats ſhould ſpread ever ſo wide aſunder, and the weight was put in the middle of the bite, the ſweep would only make an acute angle, and a large object might be miſſed, though the boats did paſs on each ſide of it; but ſuppoſe the weights are put about fifty fathoms aſunder, the ſweep will then encompaſs at leaſt forty fathoms, and according to the length of the line and depth of the water this may be increaſed; the longer the line the better, provided the ſpot will admit of it.

The boats ſhould advance but very ſlowly, and the ſweepers ſhould hold the line in their hands all the while; when they may eaſily perceive how the weight (a ſtone or bullet ſlung with rope yarn) drags along the bottom till they are brought up by the two weights (ſpread at proper diſtance) to a ſearching ſweep, is full ſufficient, more is only a hindrance, and inclines the ſweep to an acute angle; nor need each weight to ſuch a line exceed four pounds. The boats ſhould always keep farther aſunder than the diſtance of the weights; but this ſpreading ſhould be moderated alſo, otherwiſe both the weight and bite of the ſweep will riſe from the bottom.

Ebb is the only time for ſweeping; but as ſtill water is of ſhort duration, add to this, that the young flood is ſtronger than the ebb in proportion, at the ſame diſtance of time from dead low water; the operation ſhould commence at leaſt half an hour before the tide is ſpent; for ſweeping with the tide is on every account more advantageous than ſweeping againſt it; therefore ſuppoſing four different ſweeps were requiſite, the firſt and the laſt would have the tide in favour, and the two mean ones in what direction neceſſary might be at ſtill water.

In the ſweeping, the boats ſhould advance very gently, during which time the operator will diſtinctly feel the ſweep, either dragging after him by a peculiar noiſy tremulation of the line, or otherwiſe, if the ſweep riſes from the bottom, it will have a ſilent ſhaking. The moment the ſweep has catched an object it becomes tought; then the rowers ſhould pull hearty, and the ſweep ſhould be hauled on board till the boats are forcibly as it were brought up by the object; when both boats are hauled home by the object, we may eaſily diſcern both the magnitude, and whether it is the real one or not, and then act accordingly.

When the object is found, prudence demands to mark the place; this may either be done by fixing a buoy on the ſurface of the water, or ſinking one under it. But what is of much more conſequence than either, is to take good land-marks (if there be any) ſuch as will always conduct him upon the very ſpot, ſhould either of the buoys be loſt.

Land-marks depend upon geometrical principles; three are all that are requiſite, and the nearer they approach a triangle the better; but even two will ſuffice, provided they are well choſen. All that I ſhall ſay on this head is, that the objects on ſhore which conſtitute the land-marks ſhould be choſen the fartheſt removed from each other, which poſſibly the proſpect on ſhore will admit of.

We now proceed to the preparation for the weighing. What I have ſaid above of the nature of the bottom, and of the veſſel itſelf, muſt here be remembered; thoſe obſervations lead me farther to remark, that it becomes requiſite to make the materials ſtronger than what a calculated weight of the veſſel may ſeem to demand; for a veſſel may not only increaſe its weight by being filled with ſand or mud, or by a ſtrong coheſion to the bottom, but even by being water-ſoaken, and thus require greater purchaſe than its bulk, or known contents would indicate; but the ſtrain laid on the weighing materials is a continual dead weight, and thence ſoon deprives a hawſer of its elaſticity, which is the marrow of its ſtrength. Again, cables and hawſers for that work ſhould be laid much looſer than for common ſea ſervice. The ſofter a rope is laid the ſtronger it is for immediate uſe; but the harder the better for long wear. The leſs tar in a rope the better; but care ſhould be had in the tarring leſt the yarns be burned, which is too frequently the caſe. All ropes, hawſers, and cables ſhould be made in a fair day, or under a roof. All ropes made in a fair dry day will even improve with age, but on the contrary a rope made on a rainy day, will not only become black and diſagreeable to the eye, but, if laid by, will be ſubject to rot at the heart.

The gears for weighing a veſſel are prepared and laid on the object in various ways: I ſhall here conſider briefly the different methods that have come under my obſervation.

When a cable or hawſer is uſed in its full length, without making it into any particular form, it is generally called in this operation a ſweep*; when however the gears are ſo contrived as to jam round the whole veſſel, it is generally termed a cradle.

Sweeping is the eaſieſt kind of operation, and appears to be the leaſt expenſive; but frugality in operations of this nature is liable to become an *ignis fatuus*, and prove the reverſe to what was intended.

There are ſundry ways of ſweeping a veſſel with an intent to ſling and weigh her; ſome have laid on a ſingle ſweep either at ſtem or ſtern at low water, thereby intending to lift her an-end, in order to get a hawſer under her keel; but this method will ſeldom anſwer the expectation it appears to promiſe; and more eſpecially, if the veſſel be of any burthen.

Others have taken a round-turn about the veſſel with their ſweeps, in hopes thereby to ſecure the object; and this method, as I have been informed, was the method the king's people took with the diving veſſel; but that method is liable to a number of inconveniencies; it ſubjects not only the veſſel to cant, or the ſweeps to ſurge under the veſſel's bottom, but the hawſers chafing themſelves to pieces, it may expoſe the people in the work to great danger.

There is ſtill another method that ſeems to promiſe much in theory, but is very difficult to put into practice; namely, to lay on two different ſweeps in contrary directions all round the veſſel, then to run a jewel down on each ſweep, to the ſtem and ſtern

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* By ſome it is called a *Swift*, or *Swifter*; but according to the definition of the term, I think a ſwifter is more ſynonimous to a cradle.

of the veſſel; then to carry the ſweeps back again; the ſtern ſweep to come under her bow, and the ſtem ſweep to come under her quarters; then to run a jewel down and jam all the ſweeps amidſhips.

Out of the various methods of ſweeping, I believe I purſued that which was, in practice at leaſt, the moſt eligible. But though it appeared to me then both the cheapeſt and the eaſieſt in the execution, (and I believe would have been effectual, if infidelity had not prevented it) yet it is not what I, upon mature conſideration, now approve of, and therefore ſhall not at preſent recommend; but ſhall take this opportunity to explain a method that promiſes better ſucceſs on the like occaſion; namely, cradling the object.

There are different kinds of cradles that have been made uſe of for weighing of veſſels; one ſort is made of four cables of equal length and bigneſs, in proportion to the largeneſs of the object and depth of the water. Each cable has a large thimble ſpliced in at one end, through which each alternate cable is reeved, ſo as to form an angular loop, with four ends, by which it may be drawn cloſe to the object. To make the cable the ſtronger, or leſs liable to chafe, it is ſerved and parcelled on the part that comes home to the object; and to make it jam the cloſer, ſome have put large blocks at the ends, inſtead of the thimbles; but this latter alteration is needleſs, and even is ſubject to inconveniencies. But another more eligible improvement, is a contrivance, whereby the cradle is prevented from drawing cloſer than the largeneſs of the object, leſt the great ſtrain in the weighing ſhould cut the veſſel through, and ſeparate her upper work from the bottom, eſpecially if the ſhip is old, and laden with a heavy as well as a rich cargo; which, as I am informed, was the caſe of a Spaniſh ſhip, laden with ſilver, the great value of whoſe cargo firſt put the artiſt upon finding out ways and means to prevent ſuch an accident, and his method was attended with the wiſhed-for ſucceſs.

The operation of laying on this kind of cradle is as follows:

Four crafts are to be moored at equal diſtances from the object, and at right angles to themſelves. The different cables that conſtitute the cradle ſhould each have a ſtout rope, or ſmall hawſer ſpliced to its end, in order to give full length; theſe parts ſhould be carried on board the crafts, ſo that the end may be on board the one, and the thimble on board the other.

Reeve them at an equal diſtance, each cable in its reſpective thimble; then tie the reeved parts together with a rope-yarn, and fling to each thimble a weight in order to ſink it the better. Greaſe the thimble and the cable as far as it is to ſlide through.

When every thing is ready, let each craft drop the cradle at one and the ſame time, and let them pay out the hawſer, till the cradle has fairly taken the bottom all round the object. Then let each craft warp a-ſtern, with the end of the hawſer of the cradle afore; then let them clap the hawſers to their reſpective windlaſſes, heave home a great ſtrain, keeping all tought abaft, ſlacking a little of the mooring as they heave to the object.

When the cradle is well jammed cloſe to the veſſel, let all the crafts heave down at low water, belay all ſafe with ſtout ſalvages and loff-tackles. Care ſhould be had that the crafts are ſtout enough for the object; and when that can be depended on, the operator ſhould not be intimidated by the firſt ſtrain, till the veſſel is lifted from the ground, which is ſometimes very great.

When this is obtained, the reſt is eaſy purſued by good gears and care, *viz.* either to tranſport the veſſel by degrees into ſhallower water by the lifting of the tide, which though a ſlow, is the eaſieſt and ſafeſt method; or elſe, if the veſſels employed have ſtrong good windlaſſes, and room for fleeting, a veſſel may be hove up to the waters edge at once (independent of the tide) and carried ſafe without delay by the help of high water, till you have her high and dry.

There is another kind of cradle alſo very effectual, namely with two cables, and two croſs pieces with thimbles; theſe croſs pieces are to be ſomewhat longer than the extreme breadth of the veſſel that is to be raiſed. This cradle is to be laid on in the following manner;

Four crafts as before are to be moored at right angles to themſelves, and equal diſtances from the object, (though in this operation two may ſuffice, *viz.* one on each ſide the wreck:) the cables being reeved through the thimbles of one of the croſs pieces, about one half of the length of the object from the middle of the cables, which alſo is to be laſhed with ſome rope-yarn, but ſo that a ſtrain will break it. Then with four boats cloſe together, laying between the crafts, and either a-head or a-ſtern of the object, having on board each one part of the cable, and the croſs pieces between them, let drop the cradle near the object, and pay out cable till it is ſunk to the bottom. The boats then with the open ends are to row ſtraight on, on each ſide of the object, till they are paſt it, ſpreading all the time; then they cloſe again, and run down on the cables the other croſs piece; then each boat to deliver the ends to their reſpective crafts, when, laſtly, they heave with a great ſtrain the ſweep to the object, and proceed as before obſerved.

There are yet other methods of cradling a veſſel, that have come to my knowledge; but as I think them inferior to thoſe juſt now mentioned, I ſhall take no notice of them in this place, leſt I ſhould ſwell the work to an unneceſſary length.

Cradles are ſometimes partly made of iron chains; this indeed makes them more formidable, and has many advantages; they will ſink better, and jam the veſſel cloſer, and are much ſtronger; beſides they will bear to lay by, and ſerve often for the ſame purpoſes. All the precaution with chains is, that they be made of the beſt iron, ſtrong and faithfully wrought; and in the operation, that they do not get foul on being dropt.

With reſpect to crafts for weighing of veſſels, and their mechaniſm, nothing appears to me of greater force than two ſtout lighters, provided with a pair of formidable Spaniſh windlaſſes; and more eſpecially if they were built on purpoſe, with a fluſh deck, and windlaſſes fore and aft; the extra-expences of ſuch lighters would not be great, and they might at all times be uſeful in the ordinary way of buſineſs.

I ſhall not here enlarge on more of the uſual methods, nor particularize the various kinds of work in ſuch operations; ſuffice it, that every ſtep requires experienced ſeamanſhip, and none abſolutely but real ſeamen are fit for ſuch employ.

Having therefore treated on the moſt material points requiſite to be obſerved in the important operation of weighing a veſſel, as alſo the moſt ſucceſsful methods that have been made uſe of for that purpoſe; I ſhall laſtly deſcribe the materials I had provided for my ſecond attempt to weigh the diving veſſel, and my intended plan of operations.

But let me firſt acknowledge the obligation I am under to a few friends, whoſe judgments I conſulted; in particular John Staples, Eſq; of Stepney-Green, whoſe experience and candour added ſo much force to his arguments, that I acknowledge my materials are principally finiſhed according to the plan he propoſed, with ſome few improvements of my own; and I am inclined to think, that of all methods, this is the leaſt ſubject to miſcarry, as it is equally applicable to deep and to ſhallow water, and the materials may be fixed on a veſſel any how ſituated. The advantages of this method make me think it my duty to lay it open to public inſpection.

The materials which I prepared were theſe:

Four chains, made of the beſt Swediſh iron, each of twenty feet long, conſiſting of oval links, each about ſeven inches long, and the ſtuff inch thick. Each chain has at its end a large ring and ſwivel, in order to prevent it from getting foul, and theſe rings were parcelled with canvas and ſerved with inch rope.

To the rings of two of theſe chains were bent a ſeven inch hawſer, about thirty fathoms, (being the ſound parts of my firſt hawſers converted to that uſe;) the eyes as well as the ſplice by which they were bent were alſo ſerved with inch rope.

To each ring of the remaining two chains was fixed a meſſenger of about ſeventy fathoms of inch and half rope.

The next principal articles were two new ten inch cables, each of ninety fathoms; to both ends of each cable was long-ſpliced a ſtrand of thirty fathoms of my old eleven inch cable: theſe cables thus prolonged by the ſtrands each of 150 fathoms were marked at each five fathoms alternately with a red and green rag; from the ſplice to the middle of the cable, and from the ſplice to the end of the ſtrand.

Theſe were the materials for cradling and weighing the object, *viz.* The cables to be laid on the object as ſweeps, and the two chains, with the ſeventy fathoms meſſengers, to be run down as croſs pieces; whereby the object might be ſlung all round in a double direction, and the veſſel being weighed from the bottom, the two other chains to which the hawſer is bent were to be ready to come under the keel, and thus ſecure the object when ſucceſsfully weighed.

With reſpect to the other materials neceſſary to aſſiſt in the operation, I was alſo amply provided, *viz.* Eight loff-tackles, coged, ſtrapt and reeved in the beſt manner. Twenty-four ſalvagees, made ſo that every rope-yarn muſt ſtrain exactly alike. Six pair of ten-ſhivered purchaſing blocks, coged, ſtrapt, and furniſhed with falls of four ſtrand two and an half inch white line; add to this, cordage of various ſizes, for mooring, and other requiſite manœuvres in the operation.

Thus was I amply provided with every requiſite implement: I ſhall, in the laſt place, deſcribe the plan of my intended operation.

Four barges, each of forty tons, were to be placed at right angles from each other, and equal diſtances from the object; ſteadied with guys amongſt themſelves, and moored ſufficiently aſtern in manner as ſuitable to the place, and each barge to have ten tons of ſtones on board.

A boat being placed right over the object, hauled tought, and ſituated according to ſtem and ſtern of the wreck; the cradling ſweeps were to be laid on thus:

Two pair of boats, each pair to have on board a cable, half of which coiled away in each boat, and the croſs chain with the meſſenger in one ſeparately, were to lay oppoſite to each other at ſome diſtance, from ſtem and ſtern of the object.

They both were to drop the cable at one and the ſame time, row gently a-breaſt, making a half moon, till the cable was paid out, and they were ſure it had ſunk to the bottom; then the boats to proceed onward, croſſing each other, one pair keeping outſide of the other (of which particular notice is to be taken, that they might return the ſame way) and ſo carry the ends of their ſweeps to their oppoſite barges. Sweeps thus delivered to the barges to be clapt to the barge windlaſſes and hove home with a great ſtrain, till there is a certainty that the cables operate cloſe againſt the ſtem and ſtern of the wreck.

When the ſweeps were thus hove home to the object, they were to be ſlacked again, and delivered to the boats, each pair to come cloſe, oppoſite to the place from whence they ſet out, ſo that each ſweep might make as it were an oval round the veſſel.

Then the croſs chains were to be put on, the boats ſpreading according to the length of the chain, that it might run down clear, each boat keeping its reſpective meſſenger on board.

When this is done, the boats were to row hard a-breaſt; each pair turning about, and croſſing in the ſame direction as they did at firſt, then to deliver the ſtrands of the ſweeps to the barges oppoſite to thoſe that had them before, who clap them to the windlaſſes and heave a great ſtrain, till they are ſure the chains are cloſe home to the ſtem and ſtern of the veſſel, ſlacking and heaving alternately, by which the chain and cable will be laid on as cloſe to the bottom as may be.

When the cradle is thus brought to have a faſt hold of the wreck, each barge to heave home gradually to the object, ſlacking the mooring abaft, till they come upon the object itſelf with the bow of each craft; then all the ſtones to be ſhifted forward, that each barge might be ſunk a-head; when the barges were thus hove down, the ſtones to be ſhifted abaft again, in order to make the barges ſtrain the greater on the purchaſe of the cradle.

When now by the riſing of the tide the object is weighed, the two chains to which the hawſers were bent were to be ready at high water, in order to be brought under the keel of the wreck; which were to be performed thus; the two pair of boats, with the chain and hawſer, were to drop the chain a little diſtance from ſtem and ſtern of the object, and then to bring the hawſers on board the barges on the bow to correſpond with the ſweep; then to bowſe them well home with ſalvagees and loff-tackles, in order to ſling the veſſel, ready for carrying her into ſhoal water. As ſoon as this grand difficulty is got over, ſhe might either by the ſame crafts be carried into leſs and leſs depth, and gradually be brought high and dry by five or ſix floods: or elſe by the ſame mechaniſm as before, with Spaniſh windlaſſes, ſheers, and purchaſing tackles; or by two ſtout veſſels be hove up to the water's edge out of hand, according as circumſtances might point out.

Thus then I have deſcribed my materials, and the plan which I meant to execute; which I am induced to lay before the public, being firmly of opinion, it has more advantages than any other method, at leaſt that I am acquainted with, and eſpecially as it is applicable to a ſhip in the worſt ſituation ſhe can poſſibly be in, ſo as to admit of weighing gears to be laid on.

For in the firſt place a veſſel is ſlung to the greateſt advantage, namely, on her bow and quarter. Secondly, the gears will not be ſubject to ſlip off; but whether they are ſlackened or tightened, they will ſtill keep their place. Thirdly, the operation will ſuit all ſituations, deep or ſhallow water; confined or in an open place. Fourthly, it is not ſubject to fruſtration by bad weather, for when a tempeſtuous day will not admit of work, the ſweeps may be ſunk in their different directions, and taken up again, without fearing the cradle's diſengaging from the object; beſides many other advantages, which here would be too tedious to mention.

Having therefore endeavoured to throw light upon this obſcure ſubject; (on which no author I believe has ever treated before) and laid open to public view what has been kept as a great ſecret by the few who have been adepts in theſe matters, in hopes that what

I have

I have here written may prove beneficial to that part of mankind who may be ſubject to misfortunes and diſtreſſes of the nature here pointed at; I reſt ſatisfied that I have advanced one ſtep farther as a dutiful member in ſociety. And this reflection will in a great meaſure compenſate for the ill ſucceſs reſpecting myſelf in my late endeavours that has given riſe to this ſubject.

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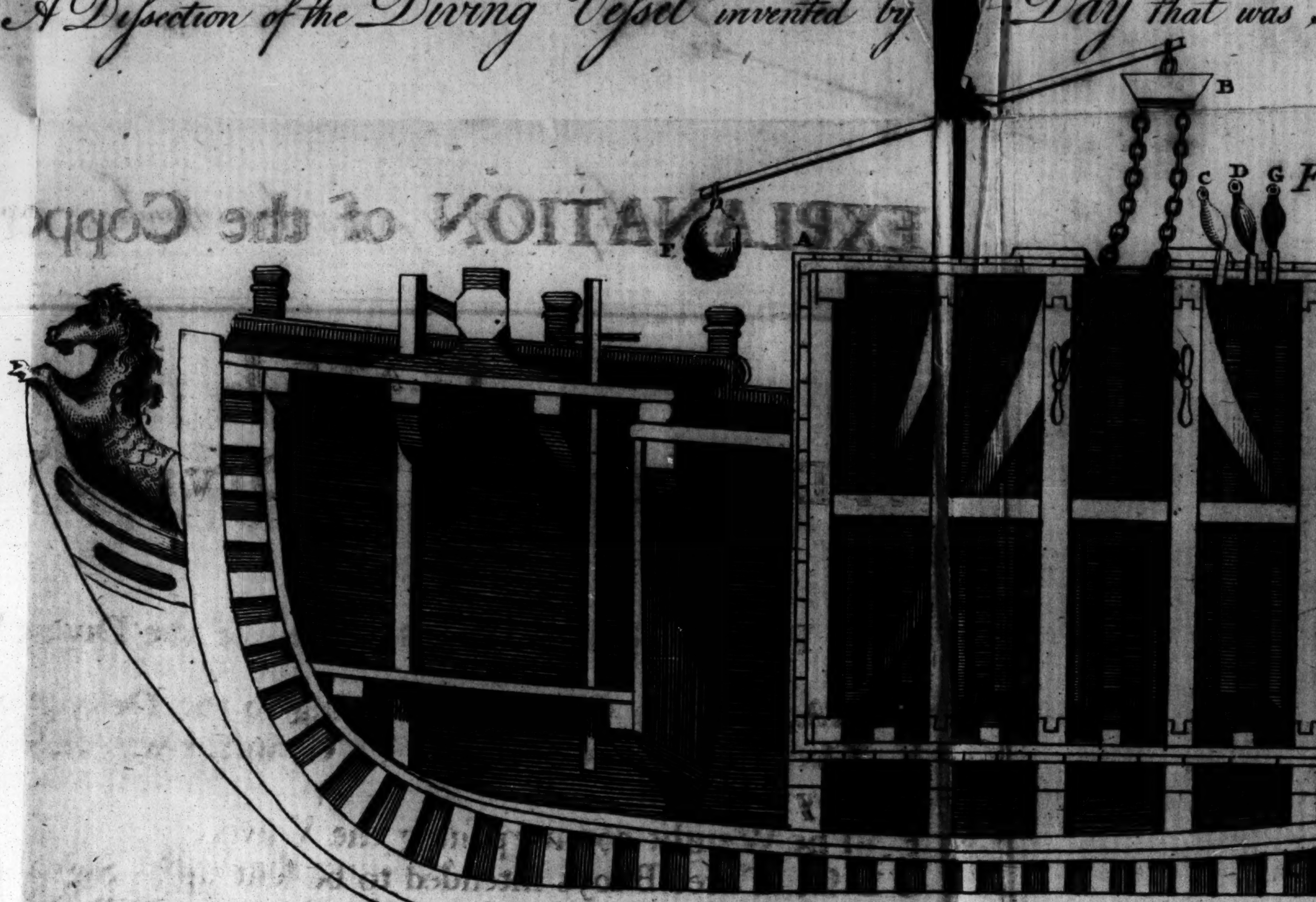
FINIS.

A Diſsection of the Diving Veſsel invented by [illegible]^{r} Day that was



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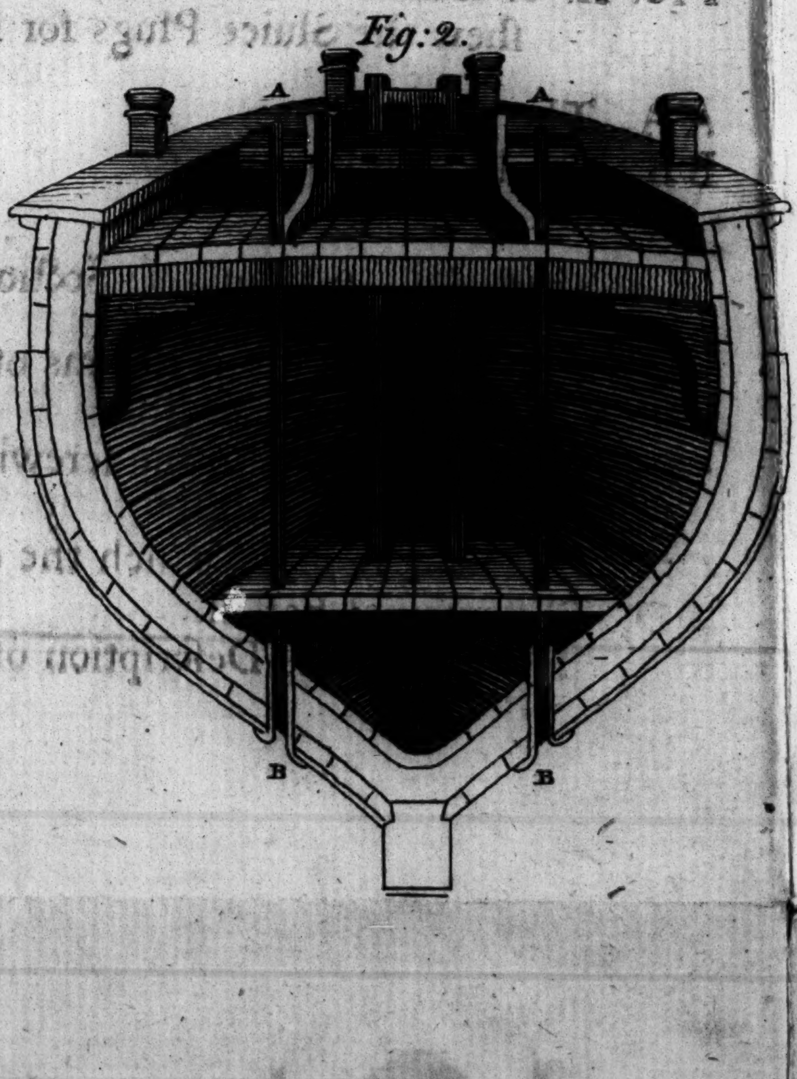

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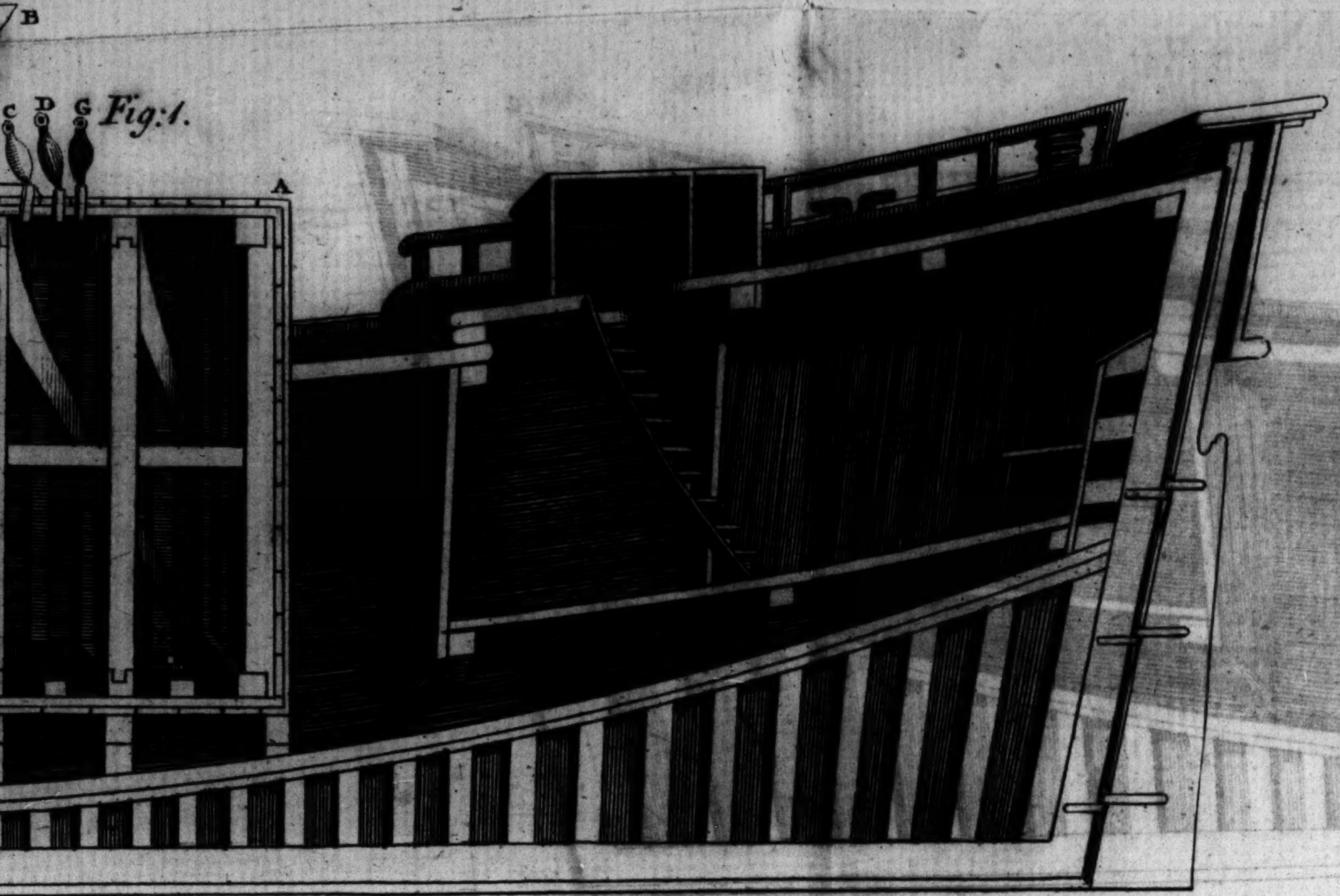
t was sunk at Plymouth Sound June 20.th 1774 & fail'd in the Experiment

Fig: 1.



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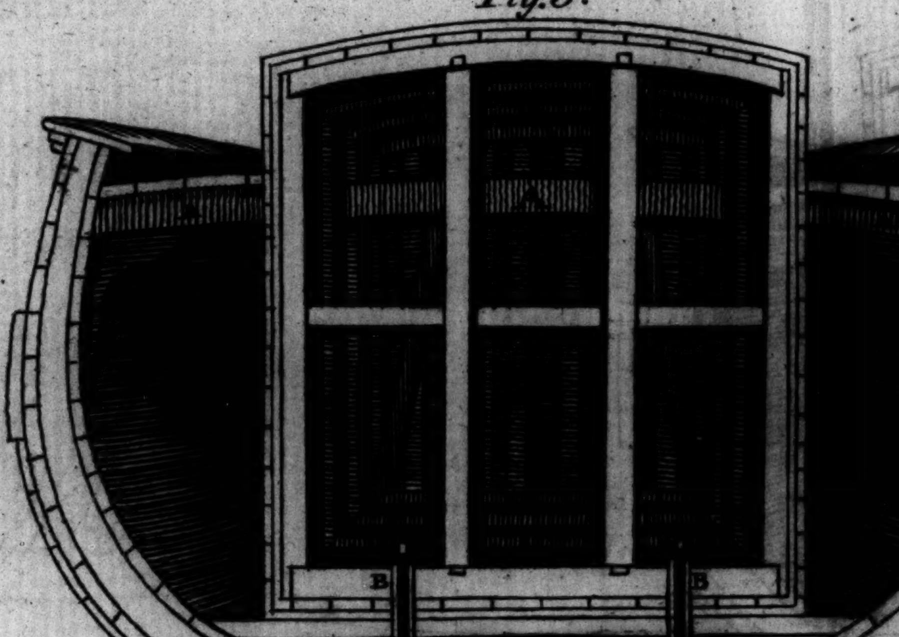


J. Macky Sculp.t Compton St.

EXPLANATION of the Copper Plates.

PLATE I.

A DISSECTION of the DIVING VESSEL.

FIG. I. is a longitudinal Section of the Diving Veſſel.

AAAA, The Air Chamber according to the Deſcription.
B, The Valve by which the Air Chamber was cloſed; ſuſpended by a Balance.
F, The Weight counterpoiſing the Valve.
C D G, Three Buoys intended to be ſent up as Signals.
E E, The Screws for diſengaging the external Ballaſt.

FIG. II. A tranſverſe Section of the Bow of the Veſſel, in order to ſhew the Sluice Plugs for letting in the Water.

A A, The Sluice Plugs.
B B, The Leaden Pipes.

FIG. III. A tranſverſe Section of the Air Chamber.

A A, One of the Midſhips Beams of the Veſſel going through the Air Chamber.
B, The Ballaſt Bolts, with the ſcrewing Nuts to unſcrew the Ballaſt Bolts.
C C, The Ring Bolts to which the external Ballaſt was fixed.
DD, The external Ballaſt.

See farther the Deſcription of this Mechaniſm, page 3.

EXPLANATION

EXPLANATION of PLATE II.

FIG. I. repreſents the Rammer and ſpiked Block, reeved as ready to let down upon the Object.

A, The Iron Rammer.
BBBB, The Four Eye Bolts of the Rammer.
C, The Block.
D, The Iron Strap.
E, The bearded Spike.
F, The Loops preventing the Block from canting whilſt under Water.
G, The Rope with which the Block is reeved.

FIG. II. ſhews the Operation of ramming down the Blocks and hawling down empty Caſks.

A, The Rammer.
B, The Block.
C, The Object.
D, The Surface of the Water.
E, An empty Caſk properly ſlung and hawled down when the Block is rammed into the Object.

FIG. III. The Barges prepared with the *Spaniſh* Windlaſſes.

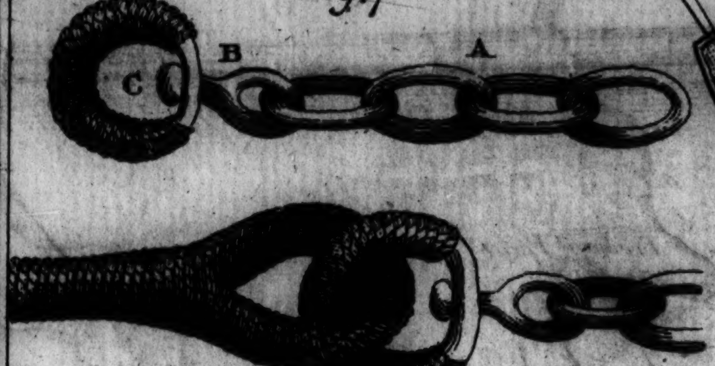
AA, The Barges.
BB, The *Spaniſh* Windlaſſes.
CCCC, The Chocks in which the *Spaniſh* Windlaſſes were laid.
D, The Shores between the Barges in order to keep them aſunder.
E, The Laſhing which keeps them from ſpreading.

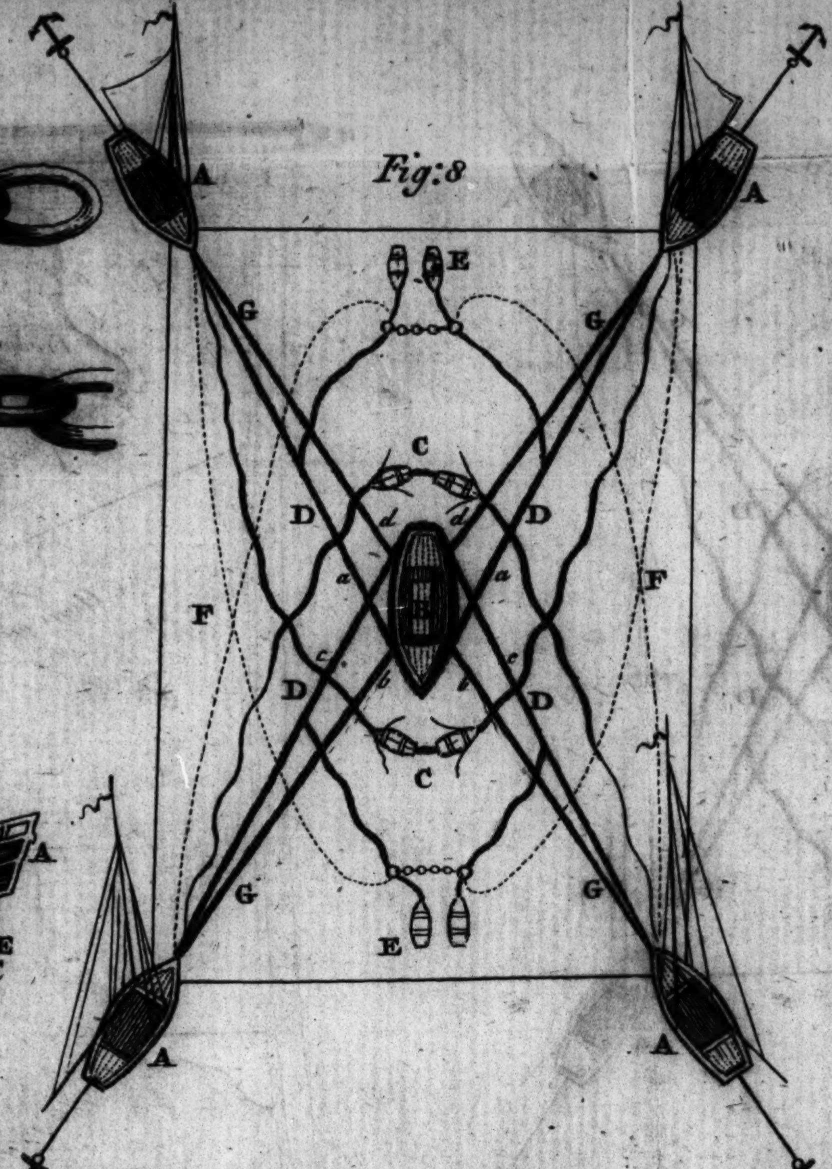
FIG. IV. ſhews the Operation employed in weighing the Veſſel.

A, The Veſſel.
B, The Barges.
C, The Fore-ſweep brought to the Aft-windlaſs.
D, The Aft-ſweep brought to the Fore-windlaſs.
E, The Jewels.
e f, The Jewel Ropes or Meſſengers.
G, The external Ballaſt.

FIG.

Fig:7





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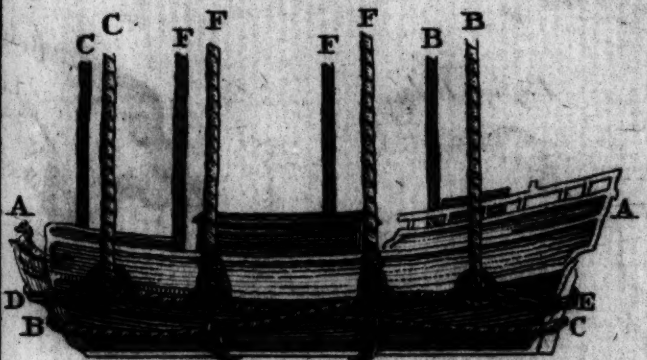

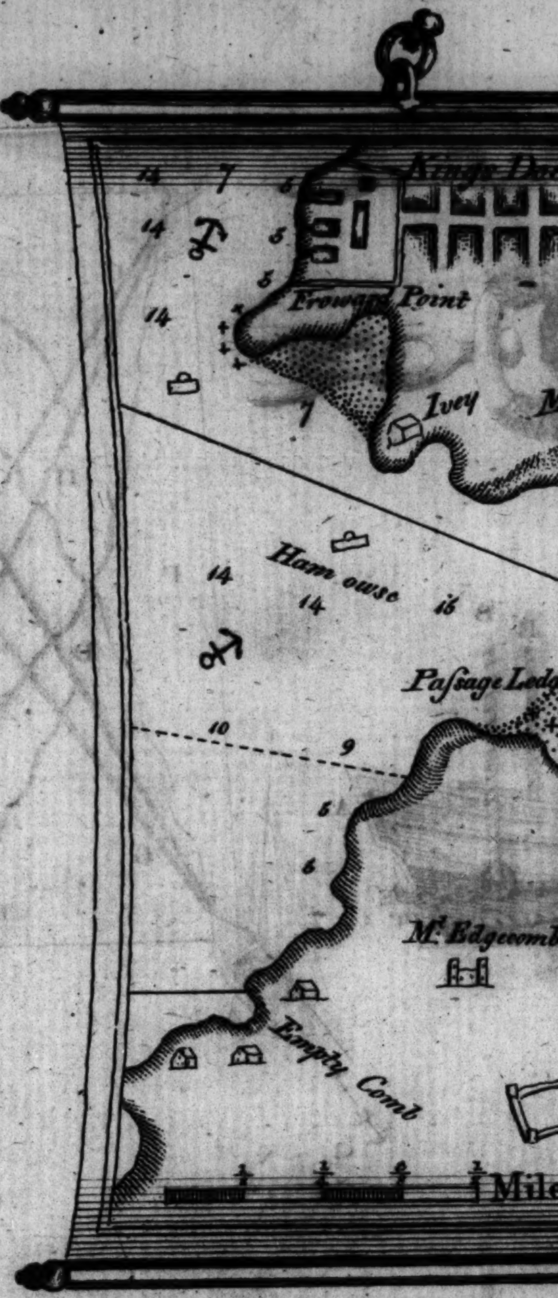

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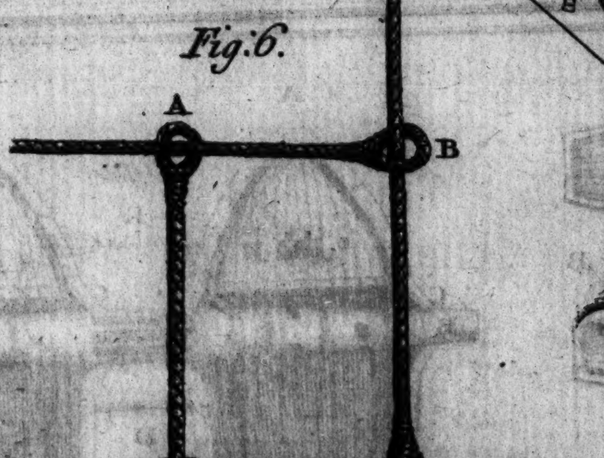

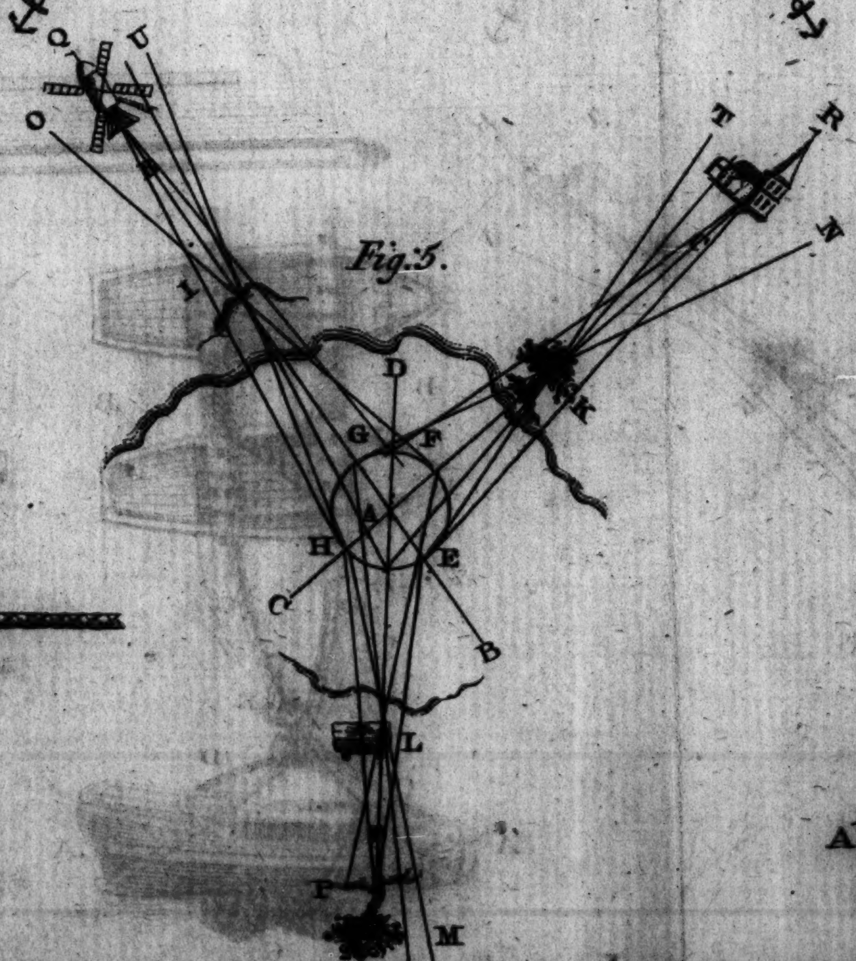

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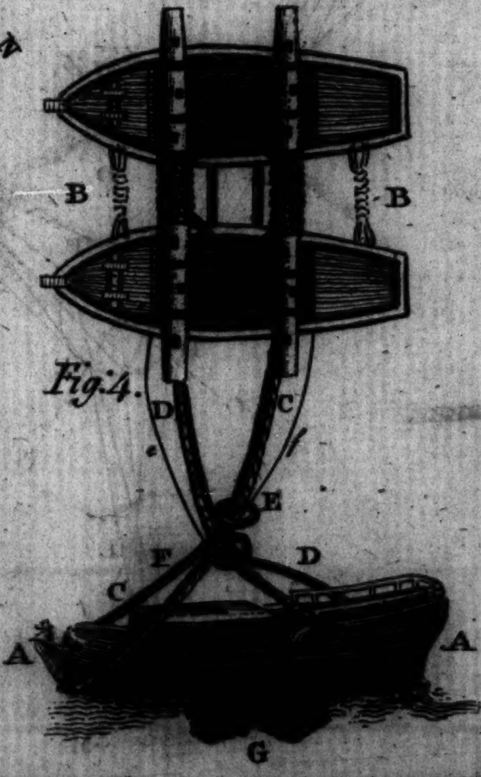

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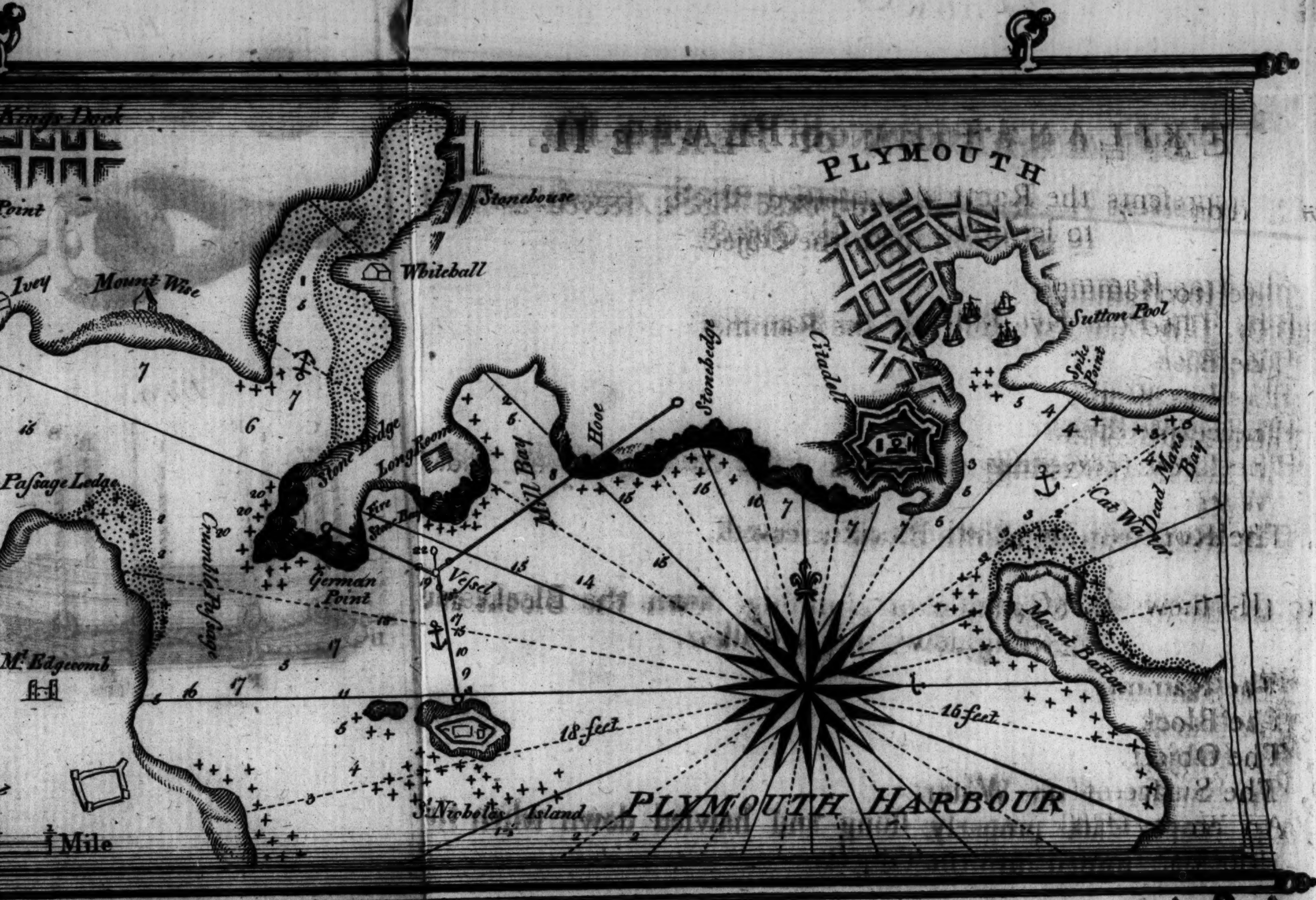
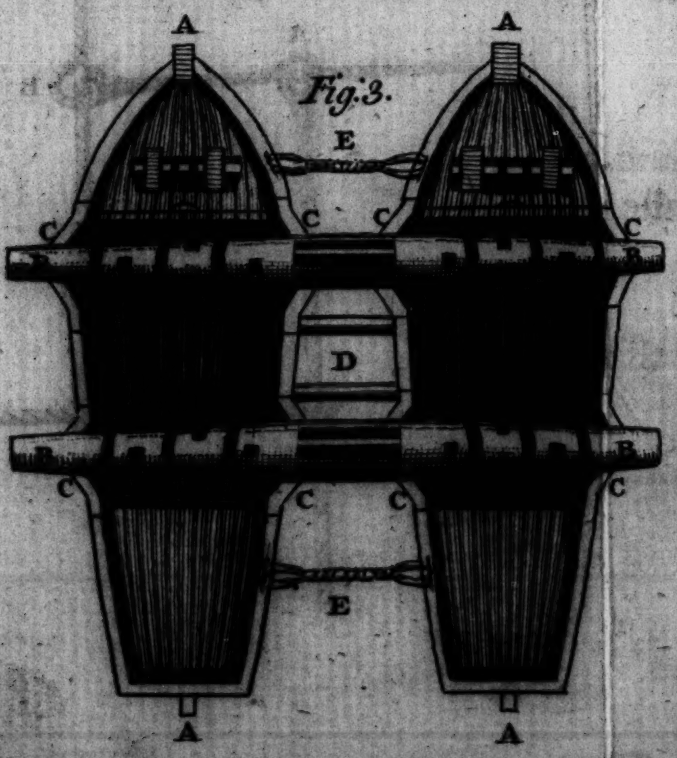
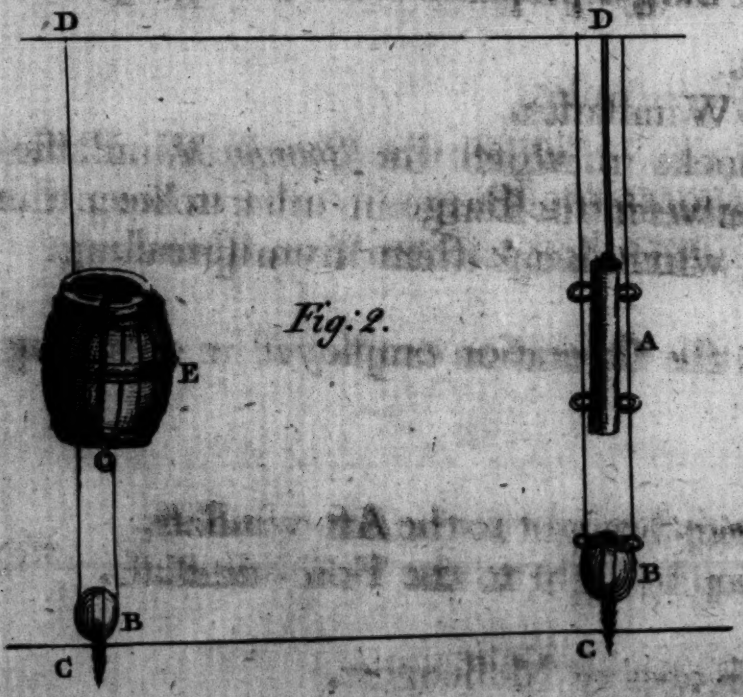
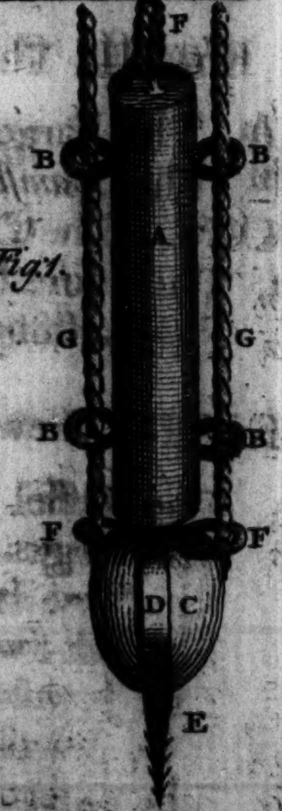
Pl. II.









J. Macky Sculp.

Fig. V. Explanation of the Theory of Land-marks.

A, The Spot where the Land-marks are ſuppoſed to be taken.
BCD, The Lines of direct Viſion of the Three Land-marks. Now in whatever Direction the Eye is removed from the Point A, the Objects muſt alter their apparent Situations; for if the Obſerver is removed to E, the Object R will be in the Line K, and therefore will appear as at K; ſince the firſt Object K will be in the Line E T. The Object P will appear at L, ſince the Line D D is varied to E P. In like Manner if the Obſerver moves to H, though he will have the Land-mark C the ſame as at A (being in the ſame Line) yet the Objects B and D will alter their Situation, as the referring Letters in the Figure denote; ſo likewiſe at the Point G, &c.

Fig. VI. The Form of a Cradle.

ABCD, The alternate Reeving of the Cradle, by which, when hove tought, it will form a *Swifter* or Cradle around the Object.

Fig. VII. repreſents the Form of the Croſs-chain, and the Chains to which the Hawſers are bent, according to the Deſcription, p. 54.

A, The Chain.
B, The Swivel.
C, The Ring parcelled and ſerved.

Fig. VIII. The Plan of the intended Operation.

AAAA, The Four Barges at Right Angles with themſelves, and at equal Diſtances from the Object.
B, The Object.
CC, The Two Pair of Boats ſweeping the Object, croſſing each other and bringing the Hawſers to the oppoſite Barges.
DDDD, The Sweeps hawled tought.
EE, The Two Pair of Boats taking the Sweep again from the Barges, putting on the Croſs-chains, and proceeding again in

Croſs-direction according to the dotted Lines F F, and delivering the Hawſers to the oppoſite Barges to thoſe that had them before, whence then the Hawſers a a will be in the Poſition b b, and c c in that of d d.

Fig. IX. The Manner in which the Veſſel is to be ſlung in this Operation.

A A, The Veſſel.
BBBB, The Fore-ſweep reeved through the Ring of the Aft-chain E.
CCCC, The Aft-ſweep reeved through the Fore-chain D.
FF, The Hawſers and Chain as exhibited in Fig. VII. which, when the Veſſel is lifted from the Bottom, is ſwept under the Keel.

In this Plate is alſo contained a Map of the Harbour of *Plymouth*, ſhewing the Soundings, the Place where the Veſſel was found, and the Place where ſhe now lies; being carried from 22 into 19 Fathoms of Water.